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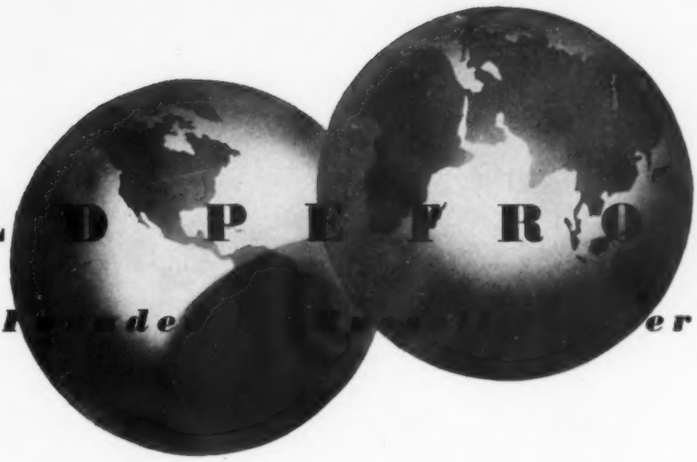

WORLD PETROLEUM

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INCORPORATING PETROLEUM EQUIPMENT EXPORTER

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

VOLUME 15 JANUARY, 1944 NUMBER 1

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SUBSCRIPTIONS: Annual subscription is offered at the flat rate of $5.00 (U. S.) postpaid. Single copies are obtainable at 50 cents. • Address all correspondence regarding editorial, advertising and subscription matters to 2 W. 45th St., New York. (Tel. MUrray Hill 2-7333). Published monthly by the Estate of Russell Palmer

BRANCH OFFICES: London: 110 Fenchurch Street, E. C. 4 • Pacific Coast Advertising Manager: Don F. Harner, 1595 Pacific Ave., Long Beach 6, Cal. (Tel. 613-238) • Mid-Continent Advertising Manager: O. F. Cozier, 415 McBirney Bldg., Tulsa 3, Okla. (Tel. 4-5555) • Mid-West Advertising Manager: Willard R. Cotton, 307 No. Michigan Ave., Chicago 1, Ill. (Tel. Franklin 2508) • Michigan Manager: R. F. Pickrell, 314 Stephenson Bldg., Detroit 2 (Tel. Trinity 1-0790) • Cleveland Manager: Frank J. Enright, Union Commerce Bldg., Cleveland 14, Ohio.

EDITORIAL

OIL INDUSTRY ENTERS A CRITICAL YEAR

In an article by Ralph K. Davies, which appears on other pages of this issue, the Deputy Petroleum Administrator for War refers to 1944 as a critical year for the American petroleum industry. No one who has followed the developments of the past twelve months and who is conversant with the conditions confronting us as we enter the new year will question the accuracy of this characterization. Since 1941 the oil men of the country have subordinated every other consideration to the primary necessity of supplying the country's all-essential military needs. They have established a record of which they and their successors must always be proud and have accomplished miracles of production in providing petroleum products for war use in volume manyfold greater than ever before has been envisioned. They faced a job of staggering proportions and that job is moving swiftly toward completion.

As we move into 1944 the situation is changed. The demands upon the oil industry are steadily increasing. The problems before it are in some respects more difficult than those confronting it on the day following Pearl Harbor. The difference is that many of them are problems for which the industry possesses no assured means of solution. While the total quantity of oil required to meet the rising demands of war plus the minimum essential for domestic use already is above the production level dictated by sound conservation the industry is unable to obtain the materials for replenishing its dwindling reserves and is denied a price for its products which would make possible such replenishment. While it is asked to produce more and more of the components of high test aviation fuel it meets increasing difficulty in obtaining adequate supplies of the crude stocks suitable for such production. This is a condition that was foreseen and fully explained long since. It could have been relieved merely by a modification of the restrictions placed on oil production but such action has been refused by an agency of government that has displayed little knowledge of oil industry conditions and no inclination to give them intelligent consideration.

There are tendencies in sight which the members of the oil industry can view only with foreboding. One of these is the disposition clearly evident in certain official quarters to discourage the development of domestic oil resources and to devote governmental assistance to the stimulation of production in other parts of the world to replace home supplies that are assumed to be entering upon an inevitable decline. From every viewpoint it is desirable to utilize oil from outside sources in helping to meet the strain imposed by the abnormally heavy demands of the present time. Such a course has been recommended by the Petroleum Industry War Council and is acknowledged to be necessary even by those who advocated restrictions upon imports under pre-war conditions. It is entirely possible also that in days to come this country may find it necessary to import petroleum in much larger quantity than it has in the past. But this surely is no reason why the domestic industry should be strait-jacketed, prevented from expansion or asked to conduct its operations at a loss.

Americans have led the way in the development of petroleum resources at home and abroad for three-quarters of a century. They have displayed a particular knack for finding oil; they have led the way in devising methods and machinery to assist in its discovery and production; they have shown their readiness to assume great risks and take long chances in carrying the drill to remote and untried regions. A wise policy for the government of the United States would be to recognize this spirit of enterprise, to encourage its citizens to employ their skill and capital in helping to satisfy the growing worldwide demand for oil, and to use its influence to protect rights and interests legitimately acquired from other governments—a policy that has been conspicuous by its absence during the past decade. Such a program would be far less likely to involve the nation in difficulties than would direct governmental participation in oil enterprises in foreign lands.

Under the compulsion imposed by war the federal government has extended its authority over every branch of the oil industry and is employing it as an essential fighting arm. The industry on its part has pledged its full energies to the fight for freedom, has executed every order promptly and efficiently and has made its full share of sacrifices uncomplainingly. In doing so, however, it has not been blind to the fact that efforts would be made to extend this governmental control beyond the period of emergency and there can be no question that such a perpetuation of federal intervention is favored in some influential quarters. The members of the oil industry ask no special favors but like other red-blooded Americans enlisted in the fight for freedom they do expect that when the fight is won their own freedom shall be restored.

Attempts to create public distrust of the oil industry by falsehood and misrepresentation have been made and will continue to be made. Efforts to deny it the fair treatment accorded to other forms of private industry are certain to occur. Therefore, as it enters the year which may bring the present world conflict to a decision, the industry must not only continue to exert its utmost efforts to satisfy the growing demands of war but must be vigilant to defend itself. It must resist insidious attempts to reduce it to a position of vassalage destructive of the initiative and enterprise that have made it one of the strongest factors in the nation's progress and industrial greatness.

Butadiene Boulevard, Main Street in the Nation's Synthetic Rubber Program

FINLAND
LENINGRAD
HELSINKI
MOSCOW
Volga R.
RUSSIAN FRONT JAN. 1943
ESTONIA
NORWAY
OSLO
SWEDEN
LATVIA
RIGA
Smolensk
U. S. S. R.
LITHUANIA
KAUNAS
Baltic Sea
North Sea
300 Miles
RIEV
Dnepr R.
DENMARK
Danzig
250 Miles
Warsaw
500 M.
POLAND
Hamburg
Stettin
Elbe R.
BERLIN
Oder R.
Lwow
GALICIA
Dniester R.
Brody
500 Miles
Hanover
SAXONY
SILESIA
SUDETENLAND
300 Miles
Essen
GERMANY
CZECHOSLOVAKIA
RUMANIA
Dusseldorf
Cologne
Ruhr
LONDON
Dover
Ploesti
Bucharest
Regensburg
VIENNA
Budapest
HUNGARY
Danube R.
BELGIUM
Dunkerque
Mannheim
Saar
Ludwigshafen
Danube
MUNICH
AUSTRIA
Rouen
Pechelbronn
Havre
PARIS
350 M.
Zagreb
BULGARIA
SOFIA
Trieste
Venice
JUGO-SLAVIA
SWITZERLAND
FRANCE
Genoa
Spezia
ALBANIA
ITALY
ROME
Bari
GREECE
ATHENS
Marseille
Naples
Bordeaux
SARDINIA
SICILY
SPAIN
MADRID
Mediterranean Sea
MALTA
TUNIS
ALLIED FRONT - 1943
ALGIERS
ALGERIA
TUNISIA
TRIPOLI
Oran
LIBYA
WORLD PETROLEUM MAP

ALLIED ENCIRCLEMENT THREATENS AXIS PETROLEUM SUPPLY

Upper Left: Camel Caravan Transporting Gasoline Across the Desert.

Above: Nazi Advance on the Burning Maikop Oil Field.

FOR a long time it has been evident that oil, through machines that are powered by its products, was destined to decide the war. From the beginning the pendulum of success has swung toward the side commanding the greater concentrated strength of mechanized might made effective by liquid fuel. The initial advantage rested with the Axis because it had built up and equipped a powerful war machine against which no equivalent counter force could be brought quickly into action. This modern juggernaut rolled across Western Europe with stupefying speed because those who stood in its way were helpless against the weapons it employed. The devastating might of its bombing planes was written in the ruins of Warsaw and the ashes of Rotterdam. Valor alone could not stand against swift rolling legions conveyed by motor trucks along pathways blazed by armored tanks, mobile artillery and death dealing dive bombers.

It is, of course, oversimplification to attribute victory in a war or even in a campaign to a single factor but there is no question that the overwhelming superiority of the Nazis in the early stages of the war was due to their massing of mechanized equipment and of the arms and fuel necessary to its employment with full effect. The military authorities of Germany were the first to realize and to apply the full possibilities of modern industry to the business of war. Coal, iron, steel and oil were the materials on which they sought to build an invincible force. Not unmindful of the fact that lack of some of these, particularly oil, had contributed greatly to their failure in World War I, they attempted to forestall a repetition of that experience by accumulating a striking power so decisive that it could bring a quick decision and at the same time give them control of added resources and productive capacity sufficient to maintain their conquest indefinitely.

In the matter of petroleum, the Hitlerites laid down a comprehensive program for assuring supplies sufficient for the realization of their military plans. To begin with, on the assumption that a series of quick thrusts would bring them early victory, they accumulated large supplies of war materials in the years preceding their attack on Poland. In the five years following the accession to power of the National Socialist party in 1933 imports of petroleum products into Germany rose 250 percent and a substantial part of the increase, which was especially marked during the latter part of this period, went into storage against anticipated military needs.

As a second step in providing for eventualities German oil production was doubled during this same five year period and an extensive synthetic industry was built up which attained an annual output of roundly 2,000,000 metric tons by the beginning of 1939 while projected new construction provided for the doubling of this capacity within the ensuing two years. These preparations were deemed adequate to provide petroleum for the conquest of neighboring countries as indeed they proved to be. To further buttress the position of the Reich, however, Nazi strategists laid plans to gain control of the entire oil production of Central and Western Europe as the range of their military authority expanded. This production was roundly as follows in metric tons of yearly output.

Country	*Metric Tons*
Germany	550,000
Austria	60,000
Czechoslovakia	20,000
France	70,000
Italy	15,000
Albania	65,000
Hungary	45,000
Poland	525,000
Rumania	6,600,000
Total	7,950,000

Austria and Czechoslovakia had been annexed before the war started. Poland was overrun in 1939 and France fell in the summer of 1940. Hungary aligned itself with the Axis and Italy, with its control of Albanian supplies, was bound to Germany by the Hitler-Mussolini alliance and became an active belligerent as France tottered to its fall. Rumania was occupied in that same year.

Up to the end of 1940, therefore, Nazi air and land strength was continually rising, together with its control of oil supplies to keep its war engines in action. It was the boast of the German leaders that in the drive through the Low Countries and France they gained possession of larger supplies of petroleum products than they expended in the campaign. Unquestionably the opposition they encountered was much weaker than they had expected and the demands upon their own fuel supplies were correspondingly reduced. By dint of energetic action, Germany's own production, natural and synthetic, was being pushed upward to between 4,000,000 and 5,000,000 tons. The Hungarian fields were proving unexpectedly prolific and Austria's outturn was rising. The oil resources of the Axis probably had reached 12,500,000 to 15,000,000 tons a year, roundly 90,000,000 to 100,000,000 bbl. Control of Rumania's output, the largest in Europe west of the

Soviet Union, was of particular value in providing supplies for military operations directed to the eastward.

Inspired by the sweeping successes already won Hitler's dream of empire assumed grandiose proportions. To acquire more food and oil and the domination of a vast new area for exploitation the Russian venture was begun. The rich acres of the Ukraine, the coal and iron of the Donetz and the great oil fields of the Caucasus, perhaps too those of the Near and Middle East lying beyond, undoubtedly were the lure that led to this ambitious attempt. For a time it seemed that this invasion would result in a success as easy and rapid as those that had preceded it. German armies drove to the very gates of Moscow and Leningrad, overran White Russia and the Ukraine. In the summer of 1942 they threatened the Caucasus oil district, gaining temporary possession of the Maikop field and being halted only at the edge of Grozny. Nevertheless it was the Russian campaign that marked the turn of the tide in Nazi air power and in the oil supply essential to its maintenance. With bitter fighting going on along a front that was nearly a thousand miles in length at the time of deepest Nazi penetration it required a tremendous number of planes, tanks and guns and vast supply services to maintain them. Oil was consumed in far greater quantities than at any previous stage of the war and when the drive to the Caucasus faltered and turned back the hope of gaining access to new and greater sources of supply was frustrated. Planes, tanks and trucks were destroyed by the thousand. For the first time the Nazis felt the pinch of a lack of planes and of the men and fuel needed to operate them.

Four years of conflict have demonstrated that mass superiority in the weight and numbers of mechanized weapons and in the supply of fuel by which their effectiveness is determined are essential to final victory. Viewed from this angle the Nazi position reveals a marked deterioration both actually and relatively within the past twelve months. The circle of steel drawn around Hitler's European fortress has been coiled more tightly. Instead of carrying their front lines to the Caspian and wresting control of the Volga as they threatened in late 1942, the Axis armies have been hurled back almost to their own borders. They have been cleared out of North Africa; the Mediterranean is once more a free highway for Allied shipping; British and American troops have occupied the lower half of the Italian peninsula and are pushing their way steadily northward.

Most threatening of all to the Nazi petroleum position is the fact that the advance of the Allies has brought every part of Hitler controlled Europe —every synthetic plant, oil refinery, storage depot and transportation line—within bombing range of enemy planes. The daring raid of an American air force against the refining centre at Ploesti was made from an Egyptian base and showed that it is possible to bridge distances of a thousand miles with devastating bomb loads. The shuttle runs from Britain over Western Europe and Italy to North Africa have covered even longer flights. Experience in aerial warfare has shown, however, that to be fully effective in paralyzing the activities that make enemy resistance possible—the production of munitions and military equipment, the means of transportation and the bases from which the fighting forces are supplied—intensive, large-scale and sustained assaults are necessary. Such attacks are capable of inflicting total destruction, of wiping whole cities off the map and creating havoc that cannot be repaired while the targets remain exposed to fresh attacks. This type of air offensive requires the use of great numbers of planes—thousands of bombers and other thousands of fighters to give them protection while executing their mission. It is this form of offensive that the Allies have adopted in their effort to blast the power of Nazi resistance at its source and it is of ominous significance that at the present time no point in Nazi-dominated Europe is much more than 500 miles from air fields under control of the United Nations. As a result, their planes participating in bombing raids can be supported by powerful fighting escorts in future operations.

In size, range and bomb carrying capacity, the planes sent against the Nazis have shown great advances during the past year while the productive capacity of the United States and its Allies has risen to the point where it is turning out planes at the rate of over 12,000 a month, four to five times the German output. In the all-important matter of the high octane fuel needed to impart full destructive power to these engines of war the preponderance of the United Nations is still greater. In a recent address Geoffrey Lloyd, Parliamentary Secretary to the British Ministry of Fuel and Power, disclosed that in the heavy raids of the RAF and United States air forces over Wilhelmshaven and Dusseldorf early in November nearly 5,000,000 gallons of gasoline was used in a 24-hour period to provide energy for the engines of 4,000,000 horse power employed. Consumption of aviation fuel at such a rate was beyond imagination a year or two ago and it indicates the possibilities contained in this branch of the campaign against the vaunted but roofless European fortress. The latest types of fighter planes that are used to give protection to the less agile bombers are easily capable of covering a radius of 750 miles or better. Consequently air armadas can penetrate to any point within the sphere of Nazi domination and most of the Hitlerite production centers are open to attack from two or more widely separated bases. The strategic advantage in being able to launch devastating raids from more than one direction is considerable.

It is entirely possible that within the next few months the circle of envelopment surrounding the Reich and its conquered territory will be drawn more closely giving the Allies possession of air fields still closer to the targets which they select for demolition. Whether or not this proves to be the case the stage is now set for the complete blanketing of Central and Western Europe with the constant aerial barrage to achieve which has long been the cherished ambition of the commanders of the Allied air forces.

While Nazi petroleum reserve and Nazi air power were at their apex in the beginning of 1941 and have declined steadily since that time the resources of the Allies in both these respects have been multiplied many times over. Not until well into 1943 was it possible to carry on really large-scale bombing over Europe but with the coming of 1944 these attacks can be conducted in far greater force and with still greater frequency.

With the growing size and power of Allied air fleets, the systematic bombing to destruction of the productive facilities upon which Axis fighting strength depends may be counted upon to extend until it covers all industrial centers of Nazi con-

(Continued on page 68)

Delivering Oil to Malta During the Height of German Bombing Attack.

INDUSTRY FACES CRUCIAL PERIOD IN 1944

Tremendous Rise in War Demand for Special Products, Pressure on Refining Facilities to Supply These Needs, Increasing Reliance on Imports and Continued Restrictions on Domestic Use Comprise Picture for Year.

By Ralph K. Davies
Deputy Petroleum Administrator for War

PRIME MINISTER CHURCHILL has warned the British people that the crucial period of the war is still ahead. I am certain that this statement will not be disputed by anyone who has followed the conflict thoughtfully. Especially am I certain that it is true as regards the petroleum industry's part in the war. And, because the crucial period *is* ahead, this means that the greatest tests—for all of us—are still ahead.

Somehow, I feel continually the necessity for emphasizing and re-emphasizing that point. Indeed, I find myself thinking of it in connection with things which have nothing whatever to do with oil or war. A few weeks ago, for example, I thought of it when I read about a great college football team which had marched triumphantly through the season, unbeaten and untied; and just won its final game—that is, it had won its final game except for the routine of winding up the last thirty seconds. Everyone knows by now of that fantastic forward pass—in those last thirty seconds—that shattered the hitherto inviolate 1943 record of Notre Dame.

I shudder just a little when I think of things like that in terms of the job that *we* have before us, because I have had the honor of being on another great team—the Government-Industry oil team—that has marched triumphantly through all barriers—up to this point.

The year, 1943, was a particularly successful one for that team, though the going was rough at times, and the difficulties were many. In spite of the serious shortages of men and materials, in spite of the inflexibility of wartime economics, in spite of the necessity for complex rearrangements in all manner of operations and the need for coping with staggering technical problems. . . .

We managed, somehow, to get more wildcats drilled than ever before in history. The fact that we did not find sufficient new oil to offset the drain upon reserves only proves that a still higher level of wildcat drilling is called for.

We in the Petroleum Administration, and I believe a majority in the Industry, were convinced that a price increase would have stimulated greater volume of exploratory drilling, which is so urgently required to sustain productive capacity to meet the anticipated increasing essential requirements for oil but, as is now well known, our recommendation was twice rejected by the Office of Price Administration and was then rejected, on appeal, by Director of Economic Stabilization, Fred Vinson.

We managed, somehow, to maintain drilling at a rate sufficient to minimize the decline in our productive capacity; and, in so doing, we provided all war products refineries with enough crude oil to make the maximum amounts of war products with available facilities. At the same time, we kept within the War Production Board's allocations and saved enough steel during 1943 to make 26,000 General Sherman tanks.

The most dramatic phase of refining during the year was the boosting of 100-octane gasoline output to more than four times the volume of January, 1942, and the making of sufficient additional progress so that, within three months, this output will be more than eight times what it was two years ago this month. This progress in the manufacture of 100-octane, and the great strides, also, in the output of other grades of aviation gasoline, of 80-octane all-purpose fuel, of toluene, of butadiene and of aviation lubricants, has inevitably caused a heavy impact upon refinery operations and upon the yield of civilian gasoline. By way of illustration, we used to get a nationwide average of about 18 gallons of automotive gasoline out of each barrel of crude oil in 1942. We are now getting a national average of only about 12 gallons. On the other hand, the 1941 yield of special petroleum war products made out of the gasoline fraction was only about one-half gallon per barrel and is now 3½ gallons—an increase of 650 per cent.

In the field of transportation came another of the year's great triumphs. One year ago at this moment, we were in the throes of a critical petroleum supply situation on the East Coast, resulting from the crippling transportation deficiency. Today, thanks to the combined efforts of Industry and Government, we have developed a degree of flexibility in oil transportation which places us in a far better position than at any time since the war began. The winning punch that brought about this victory was the completion of the 24-inch and the 20-inch pipelines: "Big Inch" and "Little Big Inch." At this time last year, even the first leg of "Big Inch"—from Longview, Texas, to Norris City, Illinois—was not finished. Today it is operating all the way to New York and Philadelphia. At this time last year, "Little Big Inch" was only a pleading look in our eyes. Today, it is all but finished from Beaumont to Norris City and, very shortly, will be in operation over its full length to the East.

Thanks to the transportation achievement, we were able to bring about something else toward which we had worked ever since the beginning of gasoline restrictions in the East. I refer to the placing of all sections of the nation on a basis

of parity as to the supply of petroleum products. We are now supplying to each of the five PAW districts the amounts of automotive gasoline which the ODT has told us would put motorists in all of those districts on an equal basis, with proper weight given to differences in local conditions, such as availability or non-availability of mass transportation, distances to be traveled and other factors.

However, even after the oil has been discovered, produced, refined and transported, one of the most complex of all of the petroleum problems still remains: that of distribution. Until last fall, when the improvements in transportation began to make themselves felt substantially, this job, as far as PAW was involved, was concerned principally with the perplexities arising from the East Coast shortage. The job has been accomplished under the general provisions of three basic documents: Petroleum Administrative Orders No. 1 and No. 5, and Petroleum Directive Number 59.

The first of these makes it obligatory that consumers and oil-distributor customers be supplied equitably by their former suppliers. It also provides effective priority assistance, in times of shortage, for the needs of preferential users, such as the military and the farmer.

PAO 5 regulates the movement of petroleum products to the East Coast from other parts of the country. It is a vehicle to assure that the transportation facilities will be used in the most efficient manner so as to make positive that we will bring into this shortage area the maximum amount of product available, and channel the products within District One to the particular points of consumption that need oil the most. In addition the order provides ways and means whereby we can see to it that we do not create any maladjustment as between various areas of supply outside District One by draining any single area without regard for demands at that point.

Implementing the overall program, the Petroleum Administration appointed Supply and Distribution Subcommittees of oil men in all districts, and these are manned by large operating staffs, at no expense to the government. Working under PAW supervision, these committees have had the incredibly difficult task of arranging the regular receipt of thousands of shipments of different products at hundreds of supply terminals, so that current rationed demands of consumers in all areas might be filled in orderly manner.

There has been some criticism of Directive 59, and certainly no one pretends that it is—or could be—perfect. But I do not know how we would have been able to supply the East Coast without it. Considering the staggering size and the complexity of the job, I have no hesitancy in saying that I sincerely believe that it has been done outstandingly well. We have tried at all times to administer Directive 59 in such a manner as to deal fairly with all units of the industry, large and small, and to see to it that the impacts of war do not—if we can avoid it—fall upon some companies more than upon others. We believe that the joint operations of this PAW-Industry program have served to distribute supplies to the points where they are needed, and have done so equitably, both as to companies and as to consumers.

Looking back, then, over the year 1943, I believe that it will be agreed that the Petroleum Administration for War and its partner, the oil industry, are entitled to feel just a bit of honest and justifiable pride. However, having indulged this sense of pride, we now need to forget about all that and get on with our work. The crucial period, as I have said, is ahead. We know we are not in the last thirty seconds of this struggle. We do not even know whether we are in the last quarter, or the last half. We do know that the job, as far as we of petroleum are concerned, is becoming tougher rather than easier. This is true of every phase of oil operations.

I have spoken of how the Government-Industry team managed, in 1943, to get more wildcats drilled than ever before, but even this record total was not all that we wanted. We had estimated a need for 4,500 wildcats for the year. Actually, about 3,400 were drilled. In 1944, we do not think that even 4,500 will be enough: we are asking for 5,000. How many we shall get remains to be seen. Unless exploratory activity yields greater returns and sizeable new reserves are discovered and opened for production, the productive capacity of the nation will continue to decline, slowly but surely.

Even with credit given to new fields likely to be found, and with an increased tempo in development drilling our productive capacity will decrease from the present value of about 4½ million barrels per day to about 4-1/3 million barrels per day by the end of 1944. Balanced against an anticipated demand of about 4.7 million barrels per day during the latter part of 1944, it is obvious that the deficit of at least one-third of a million barrels per day must be supplied from dwindling stocks and from sources outside the United States.

In an attempt to make certain that there will be no failure in meeting future essential civilian and expanded military requirements of petroleum we have programmed a substantial increase in crude oil production in the Caribbean area to more than 1,000,000 bbl. daily by the end of this year. This will represent about the peak of productive capacity for presently known fields in the Caribbean area. Increased Caribbean production is, of course, important because it is the source of foreign oil nearest to the United States. Increased production is programmed also in the Middle East—the Persian Gulf area.

With respect to both these sources of crude oil for supplementing hard pressed domestic supplies, the following comments must be made: The success of our import program from the Caribbean is dependent upon our ability to develop productive capacity of the types of crude oil required in the time and to the extent necessary. Considerable of the Caribbean oil is of the heavy, fuel-yielding crude, whereas our immediate need is for the lighter types containing larger proportions of war-needed products. Needless to say, a major factor, also, is the availability of tankers and the safety of the sea lanes.

The ability to utilize greater quantities of Middle East production is dependent not only upon the availability of tankers and the safety of the sea lanes, but also upon the capacity of the refineries there. In this connection, any substantial increase in the use of Middle Eastern oil will involve construction of additional refinery facilities requiring both time and scarce materials.

If all the many factors involved in the success of these programs coincide perfectly, there will be sufficient crude oil available to meet all the essential civilian and military requirements that we can foresee through the year 1944, providing always, of course, that some sudden upsurge in military demand does not unexpectedly occur.

Gasoline Going Ashore to Aid the Invasion of Italy.

But, it is because we cannot afford to take chances with our ability fully to meet essential civilian and military demand that we are attempting in every way possible to augment our domestic crude oil supply. This is essential in order to provide a cushion against the failure of any part of the foreign program during 1944 because of the occurrence of events over which we have no control, and to provide sufficient new productive capacity for 1945 and subsequent years. This is something that has given us many sleepless nights in PAW.

There have been charges that the British have been hoarding their oil resources thus making it necessary for the United States to draw inordinately upon its reserves. The truth is that American and British oil resources have been employed jointly from the beginning of hostilities. It is true that the use of Middle Eastern oil was restricted somewhat during the period when the Mediterranean was unsafe for tankers, and when our allied tanker fleet was dangerously inadequate. Ships and time being scarce, we had to move as much oil as we could from the nearest source of supply. In the case of North Africa and England, that nearest source was the East Coast of the United States.

It should be pointed out, also, that the oil of the Middle East is not exclusively British. The United States has a large interest in that region. Regardless of ownership, however, the increasing number of tankers available has made us able to use more Middle Eastern oil, and we will use it to the fullest extent possible—in the future as at present and as in the past. Insofar as we can see today, however, this oil will not result in substantial relief to the United States except for the long term, because the refining capacity is so limited and because there is neither the time nor the steel to increase that capacity notably in the immediate future. What the Middle Eastern oil will do principally is provide increased supply to the battle areas which it can most effectively serve and thus reduce, by that amount, the supply required from the United States.

Considering all of these factors, I believe that our only conclusion can be that we stand today at the point where we no longer have enough oil in the United States to go around, and the reason we do not have it is that such prodigious amounts are required for war.

Pressed though we shall be to maintain adequate supplies of crude oil, we shall likewise be pressed for refining capacity, particularly for the kind of capacity needed to provide the products that we require. Especially shall we be pressed for cracking capacity, to give us the base stocks for aviation gasoline and the refinery gases from which come such important blending agents for this aviation fuel. Complicating the problem is the lack of the needed quantities of the desired crudes.

I think that the public should know that the outlook for any increase in civilian gasoline supplies is not encouraging. From the military estimates now in our possession it would appear that the allowance of gasoline for civilian consumption is more likely to decrease than to increase. On the basis of military estimates now in our possession, I doubt that this can be avoided. I consider it very possible, also, that there may be further deterioration in gasoline quality—both as to volatility and as to anti-knock characteristics—as more and more of the lighter hydrocarbons, and more and more tetraethyl lead are required for petroleum war products.

As to transportation, I have already commented upon the great improvement in the outlook domestically. We can still anticipate, however, special transportation problems of a critical sort. The interruption of tanker deliveries to the Pacific Northwest, for example, could cause serious trouble. Capacity for movement to the East Coast is expected to be approximately 1,625,000 barrels daily by spring, although it may become necessary to divert a part of this capacity in order to increase movements to the West Coast, where the supply situation has become increasingly serious.

From the standpoint of the world situation, the availability of more and more tankers should make for a greatly improved position with a flexibility that ought to give a better balanced world supply.

Considering the marketer, the outlook continues on the discouraging side. Shortened supply and lack of help combine to make his lot a worrysome one.

All of the industry's operations, from well to driveway, will continue to be affected, of course, by manpower and materials. As of today, I would venture the forecast that the former will become progressively more serious, while the latter will gradually ease.

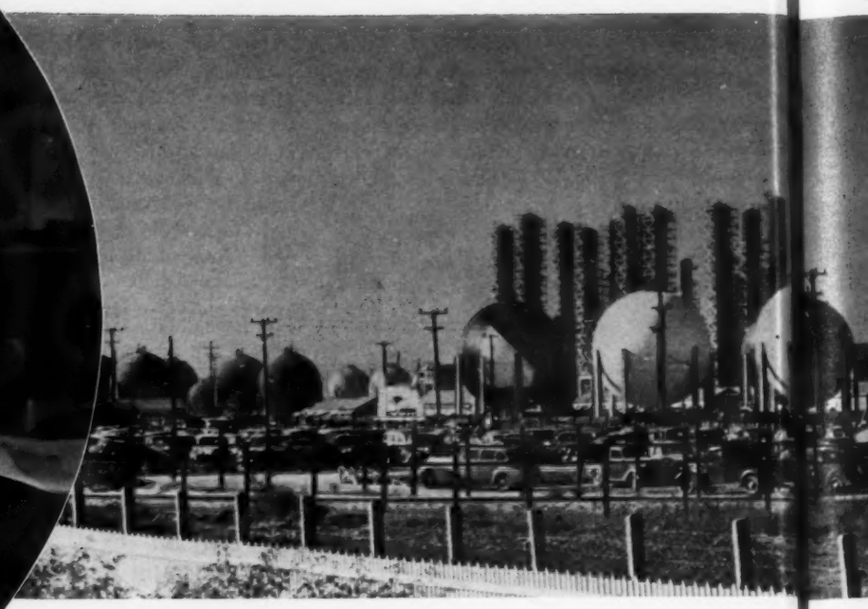
So much for the physical factors which will concern us during the year ahead. There are other factors, too—intangible but none the less potent. After more than two years of war, marked by a variety of inconveniences and a seemingly endless barrage of governmental regulations, both the public and the industry quite naturally have become restive—impatient to shake off the tethers, to indulge again in comforts—in short, to get back to what is so often referred to by that ambiguous word, "normal." After more than two years of war, it is altogether natural, too, that the succession of victories of American arms—costly though they have been—should induce an inclination, on the part of both the public and the industry, to relax. It is so easy to feel that "it's all over."

I call attention to these factors because they could become dangerous, and especially so because they can develop so insidiously. Certainly all of us would like to get away from wartime discipline; all of us would like to relax. I am

(*Continued on page* 44)

Desert Tribesmen Prepare Camel Loads of Gasoline.

Herbert Henderson, Chairman of Board.



Part of the Vast Storage Facilities of Neches.

WORLD'S LARGEST BUTADIENE PLANT READY FOR OPERATION

Representing Combined Efforts of Five Companies Serving Without Compensation its Two Units with Near-by Copolymer Plants Will Supply One-Seventh of Country's Rubber Requirements.

EARLY in 1944, there will come into operation at Port Neches, Texas, the first unit of the largest of all the numerous plants erected for the manufacture of butadiene, together with companion plants for converting the butadiene into GR-S rubber, which is the American equivalent of Buna-S, the original German synthetic rubber. This plant is designed for the production of 100,000 short tons of butadiene a year, which when co-polymerized with another hyrdocarbon, styrene, will be sufficient to produce 110,000 long tons of synthetic rubber. The present overall aim of the war-born synthetic rubber industry is the production of 800,000 long tons of GR-S rubber a year, of which this one plant will supply about one-seventh.

The choice of the location of the Port Neches plant was dictated by the fact that it is conveniently situated near the refineries of five oil companies, which undertook to supervise the design, construction and operation of the project for government account, and without any charge for management, advisory, technical and legal services. For these purposes the five oil companies organized the Neches Butane Products Company. The idea of bringing the five oil companies together in this project originated with Herbert Henderson, vice president of Gulf Oil Corporation, and the proposition was readily accepted by the government. The Neches Butane Products Company acts as the agent of the Rubber Reserve Company, the government organ which finances and is responsible for the whole wartime synthetic rubber program. The contract for erection of the Port Neches butadiene plant was let to The Lummus Company, one of the leading engineering and construction organizations in the petroleum industry. The five participating companies are: Gulf Oil Corporation, The Texas Company, The Pure Oil Company, The Socony-Vacuum Oil Company and The Atlantic Refining Company.

Personnel of the Neches Butane Products Company are as follows:

DIRECTORS:

The Atlantic Refining Company
E. J. Henry, Vice-President
W. F. Stroud

Gulf Oil Corporation
W. A. Slater, Vice-President
Herbert Henderson, Vice-President

The Pure Oil Company
C. B. Watson, Vice-President
J. P. Langfitt, Asst. to Vice-Pres.

Socony-Vacuum Oil Co., Inc.
W. F. Burt, Dir.
Dr. J. B. Rather, Dir. of Research

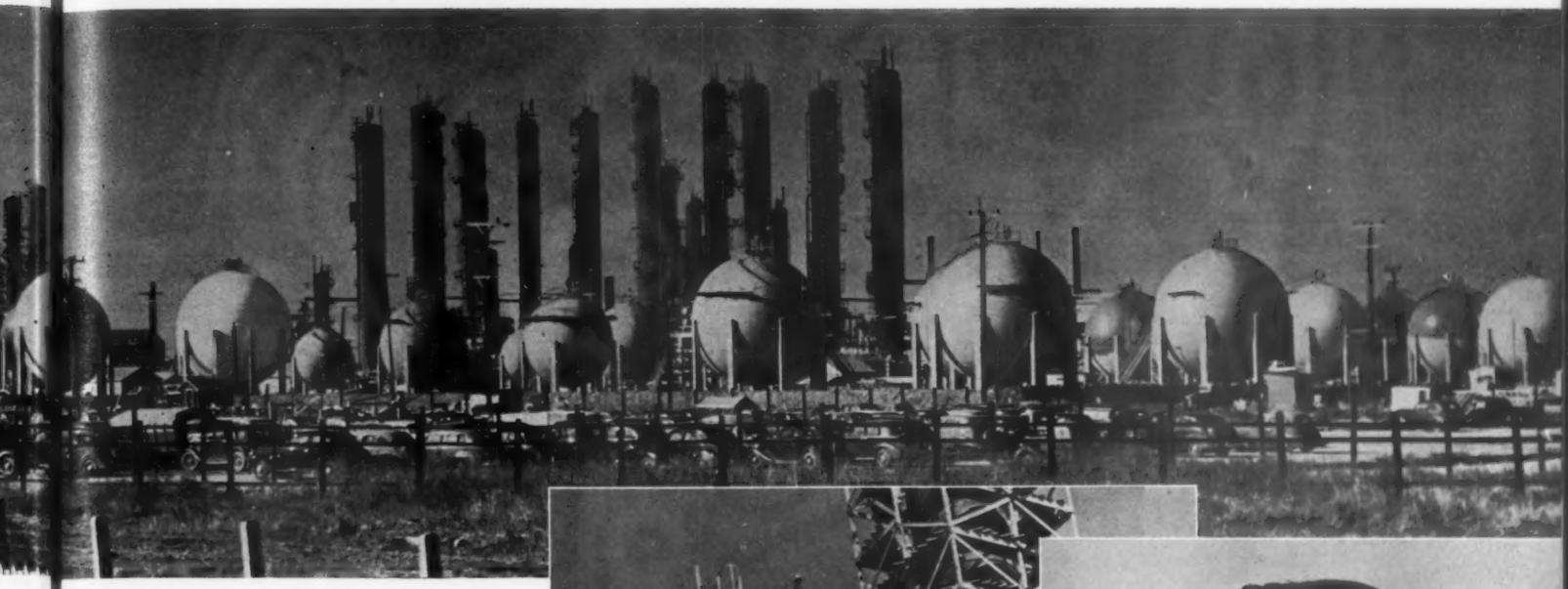
The Texas Company
M. Halpern, Vice-President
G. R. Bryant, Gen Mgr.—Refining Department

Neches Butane Products Co.
W. H. Hoffman

OFFICERS:

Herbert Henderson—Chairman of the Board
W. H. Hoffman—President
J. B. Rather—Vice-President
H. P. Arbuckle—Secretary-Treasurer
F. W. Cooper—Assistant Secretary-Treasurer

Although all of the five companies behind the project were without experience in the manufacture of butadiene, they had the full benefit of the knowledge and experience gained by other oil companies that had pioneered in this field, and which for patriotic reasons had willingly



W. H. Hoffman, President.

Left: Al de Cuir, Boss Rigger Directing the Erection of Towers.

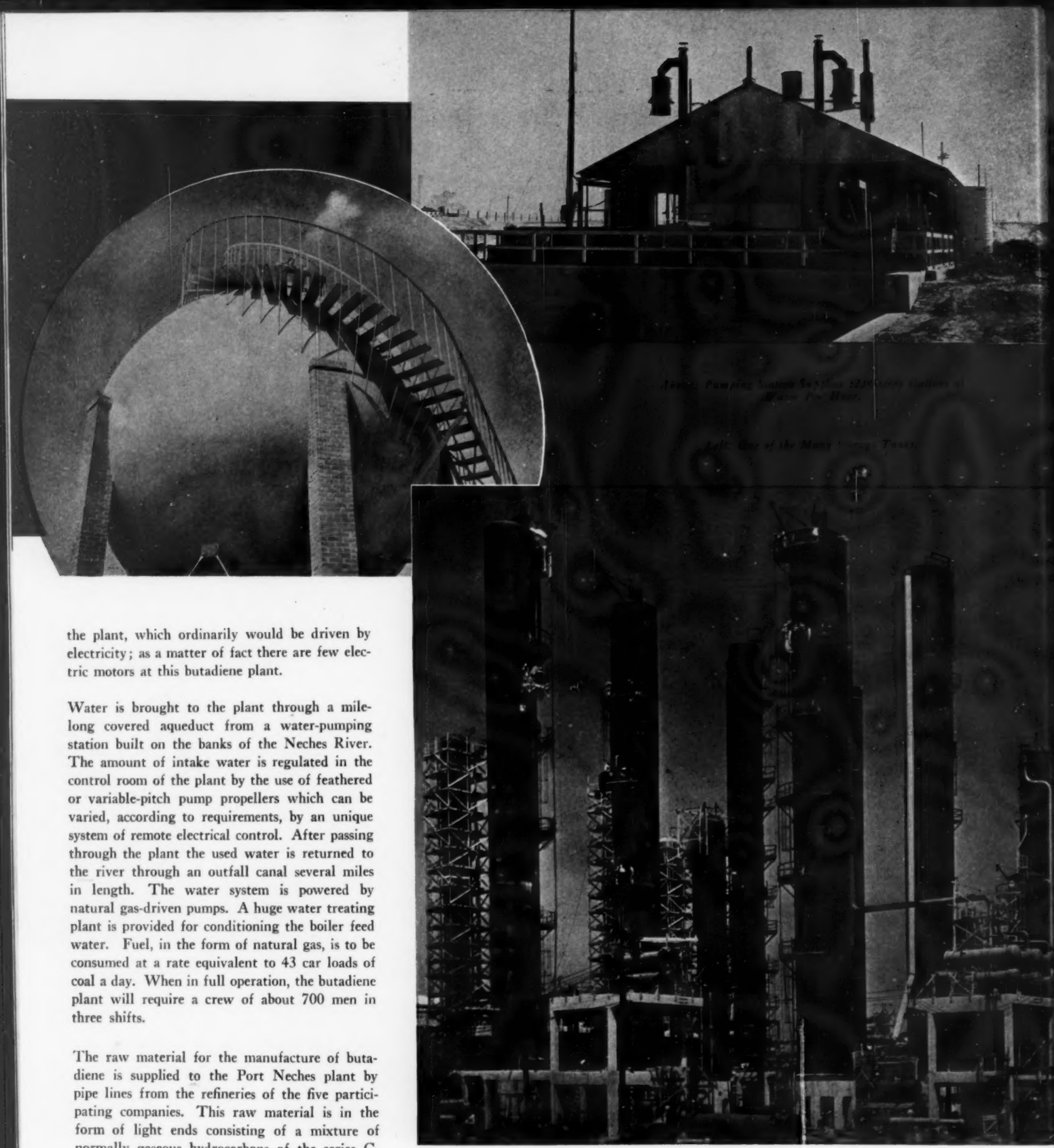
pooled their patents, technical information and "know how" for the common good.

Construction of the butadiene plant began in June, 1942, and immediately encountered the well known difficulties that have attended all war-time industry—a priority-ridden market for essential materials, shortage of labor and congestion of transportation. There was a special reason for haste, because the synthetic rubber program had to be finished on a schedule ahead of an anticipated depletion of the existing limited stock of natural rubber which could no longer be replenished in sufficient amounts.

A plant of this kind and size requires a large number of huge-dimensioned steel vessels which are usually fabricated in large and well equipped boiler shops, but all such establishments were already swamped with work. The Lummus Company was, therefore, under the necessity of scraping together enough steel rolling equipment, hydraulic presses and the like for equipping a complete vessel fabricating shop on the job site. Skilled workers, especially welders, were scarce and most of them had to be trained. Fabrication of this steel equipment on the spot saved the government considerable money. Much time was saved by welding the great towers in one piece and hauling them on special railway cradles from the shop to the site.

The chief construction difficulty was presented by the marshy nature of the terrain, and the lack of a solid foundation for the huge structures at any reasonable depth; in all, some 11,830 concrete pile foundations were provided. For setting the large towers, some of which weigh more than 200 tons on their foundations, use was made of one of the largest mobile derricks ever employed in similar work.

Since the neighboring towns of Port Neches, Port Arthur and Beaumont were not at all able to house the approximately 8,000 construction workers, the Defense Plant Corporation was called upon to build about 900 temporary dwellings and to prepare a modern trailer camp, complete with water supply, sanitation and other services. Abundant water is obtained through a canal from the Neches River. Aside from the water required for community purposes and for process cooling (308,000,000 gals. per day) the power plant, consisting of four immense steam boilers has a capacity for producing 25,000 tons of steam a day, or about 60,000 horse power. Much of this steam is used for both high and low temperature heating and boiling and a considerable amount is used to drive the hundreds of pumps and numerous compressors throughout



the plant, which ordinarily would be driven by electricity; as a matter of fact there are few electric motors at this butadiene plant.

Water is brought to the plant through a mile-long covered aqueduct from a water-pumping station built on the banks of the Neches River. The amount of intake water is regulated in the control room of the plant by the use of feathered or variable-pitch pump propellers which can be varied, according to requirements, by an unique system of remote electrical control. After passing through the plant the used water is returned to the river through an outfall canal several miles in length. The water system is powered by natural gas-driven pumps. A huge water treating plant is provided for conditioning the boiler feed water. Fuel, in the form of natural gas, is to be consumed at a rate equivalent to 43 car loads of coal a day. When in full operation, the butadiene plant will require a crew of about 700 men in three shifts.

The raw material for the manufacture of butadiene is supplied to the Port Neches plant by pipe lines from the refineries of the five participating companies. This raw material is in the form of light ends consisting of a mixture of normally gaseous hydrocarbons of the series C_3 to C_5; but as delivered by the pipe lines they are under pressure sufficient to maintain them in a liquid condition (75 lbs.). For the most part this liquid, generally referred to as butane-butylene, consists of various butylenes and the two butanes. The total volume amounts to 18,000 bbl. of butane-butylene a day (official figure), of which about one-third is normal butylene. These light ends are all produced in refinery catalytic cracking operations mostly in Thermafor catalytic units, fluid catalytic and Houdry units, and, in a sense, may be regarded as by-products of operations primarily designed to produce 100-octane aviation gasoline. At all the refineries the catalytic cracking operation is controlled so as to have as much butylene in the mixture as possible under the general circumstances.

The actual butylene delivered to the butadiene plant represents about 5 per cent, by volume, of the crude oil run to the refinery stills. The first operation at the Port Neches plant is to isolate the normal butylene from the butylene-butane mixture. After being metered as it comes from the refineries, the raw stock is mixed in a common manifold that supplies the two units which

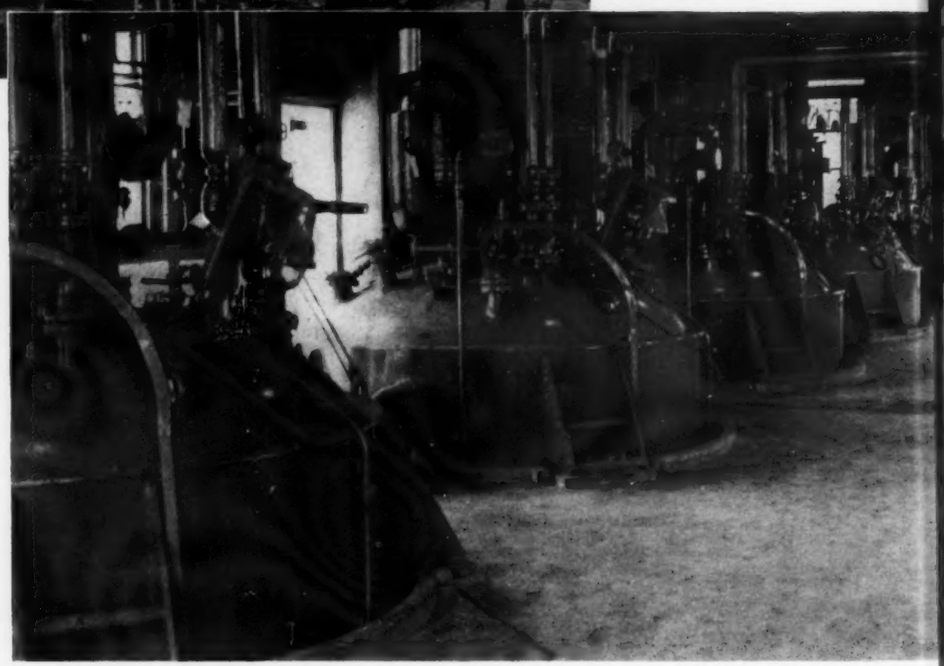
make up the butadiene plant as a whole. Each of these units is separate from the other, and each has a capacity to produce 50,000 tons of butadiene a year. The first of these units (the North Plant) is due to be started up sometime in December; the other will follow shortly.

The technological task of isolating the normal butylene from the raw mixture is an onerous one, for two reasons: the normal butylene must be obtained in a very pure condition, and the boiling temperature of normal butylene is very close to those of the accompanying light hydrocarbons. The necessities of the case require very exact fractional distillation, but fractionation alone will not accomplish the purpose. The products of fractionation must be treated with acid to remove certain tenacious impurities, and as a final step in the purification process, the normal butylene has to be separated from other impurities not removed by acid by means of a process of selective extraction.

To accomplish these various steps of fractiona-

Left: Superheaters Supplying Steam to the Butadiene Plant.

Below: Polymerization Tanks in the Goodrich Copolymer Plant.



tion, acid treatment, solvent extraction and solvent recovery in the purification step, each of the two units requires a set of ten towers of various heights and diameters, together with a corresponding number of spheroid tanks for holding the raw stock and the numerous intermediate and final products, which all have to be handled under pressure. The propane, the normal and isobutane and the isobutylene recovered from the raw stock are sent back to the refineries, where the two butanes are utilized for alkylation purposes in the manufacture of aviation gasoline. The butadiene plant thus performs a service which the refineries would otherwise do for themselves. The C_5 and higher, separated at the butadiene plant, is mostly retained at Port Neches to be blended with by-products from later stages of the process to produce an aviation base stock. Throughout the purification process nearly all operations are automatically controlled by appropriate instruments, all of which, in this part of the plant, are of standard make.

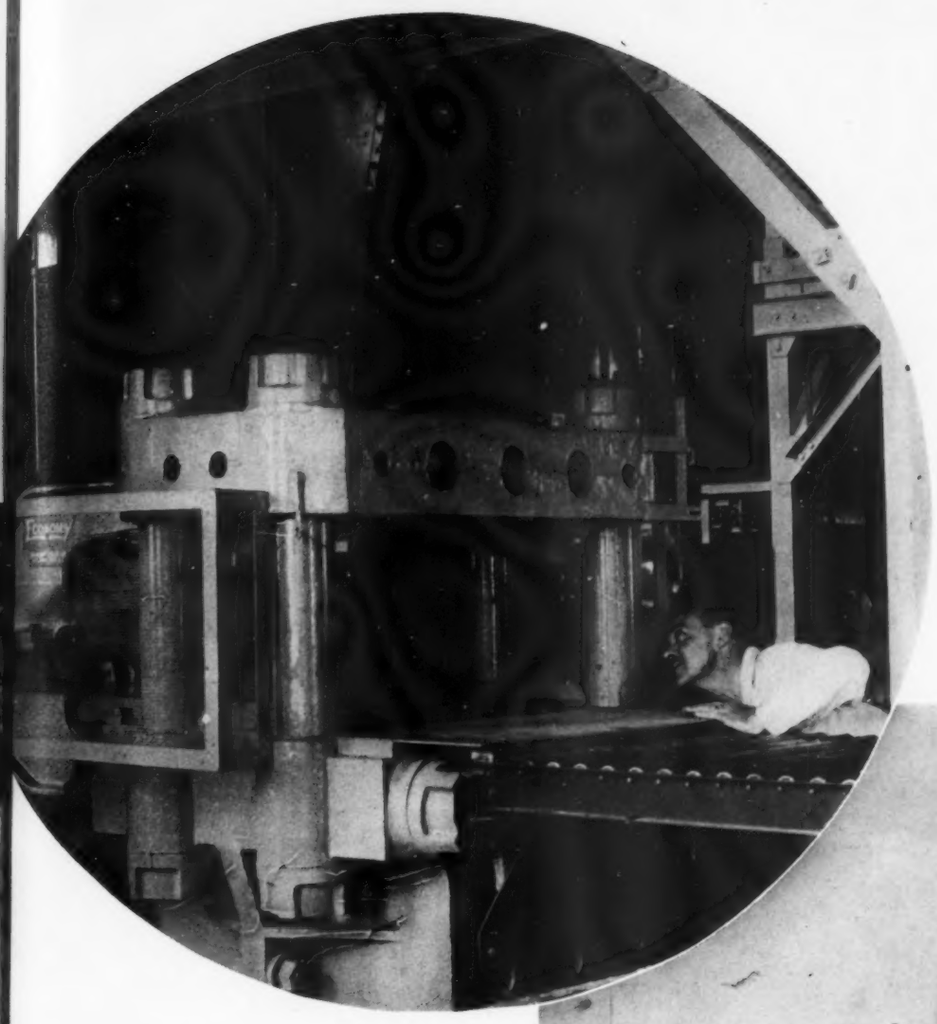
The next stage of the process is conversion of the normal butylene into butadiene by the removal of two hydrogen atoms, an operation in which the molecular formula is changed from $C_4 H_8$ to $C_4 H_6$. This step also requires very exact control of all the conditions. The dehydrogenation operation is conducted at a high temperature and a relatively low pressure. Here time is of the essence; if the incoming butylene is exposed for too long to the action of heat the butadiene produced at first will be decomposed; if the time is too short the yield will be small. For this reason the dehydrogenation operation has to conform to a strict time cycle, which is put into effect by a specially designed system of automatic devices which control the motor-operated valves that govern the movement of the products. This is the only portion of the plant for which it was necessary to design the control instruments especially for the purpose.

The dehydrogenating units contain a number of reaction vessels holding the dehydrogenating catalyst. Before entering these vessels the butylene is heated; at the same time steam from the central steam raising plant is also heated. The two are then mixed and then passed to the reactors. The function of steam in this process is largely that of a diluent, which tends to protect the newly produced butadiene from decomposition by heat. Normally, about 20 per cent of the butylene is converted into butadiene in one pass; the remainder is recycled and eventually it is all converted.

After removal of the diluting steam the reaction product from the dehydrogenating reactors is cooled and compressed by six-2000 BHP Clark angle steam-driven compressors. These compressors are the most recent design and are the well-developed angle type steam compressors where the power cylinders are vertical and the compressor cylinders horizontal on a common shaft. With this arrangement, tremendous horsepower is compacted into a very small space which has resulted in saving in construction, building and foundation costs as compared to the old horizontal type of unit.

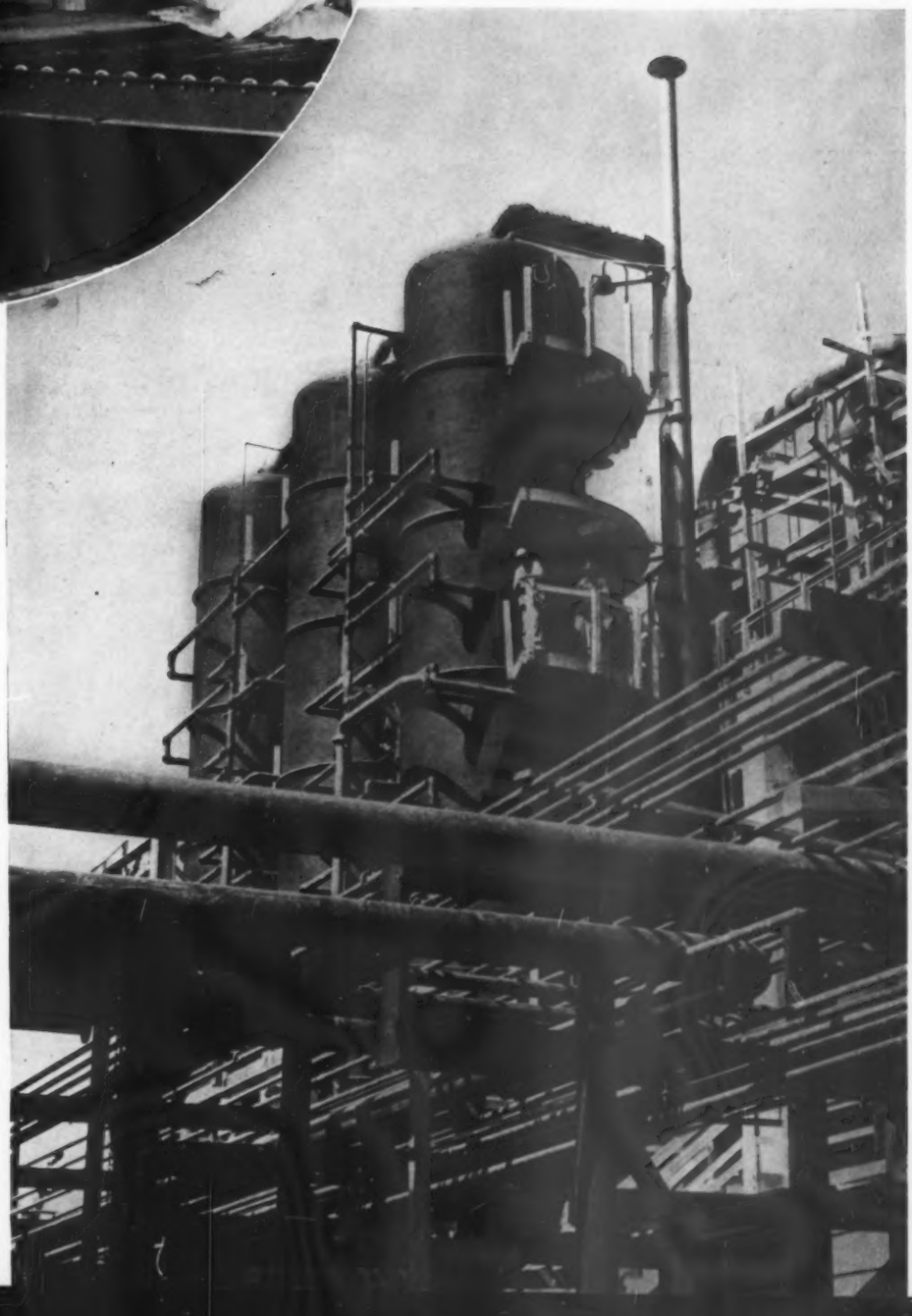
The product contains unconverted butylene, together with some impurities—mostly high polymers of butadiene.

For returning the unreacted butylene to the process and freeing the butadiene from its newly acquired impurities another complicated and elaborate installation of fractionating, treating and solvent extraction towers is required. There are, in all, eleven towers in this group, with a full complement of spheroid tanks for holding the various products. In addition, the North section of the plant has another group of five towers for recovery and purification of solvent, and one for recovering styrene from material received from the adjacent synthetic rubber plant. Altogether, the two sections of the Port Neches butadiene plant have 54 of these tall towers built or build-



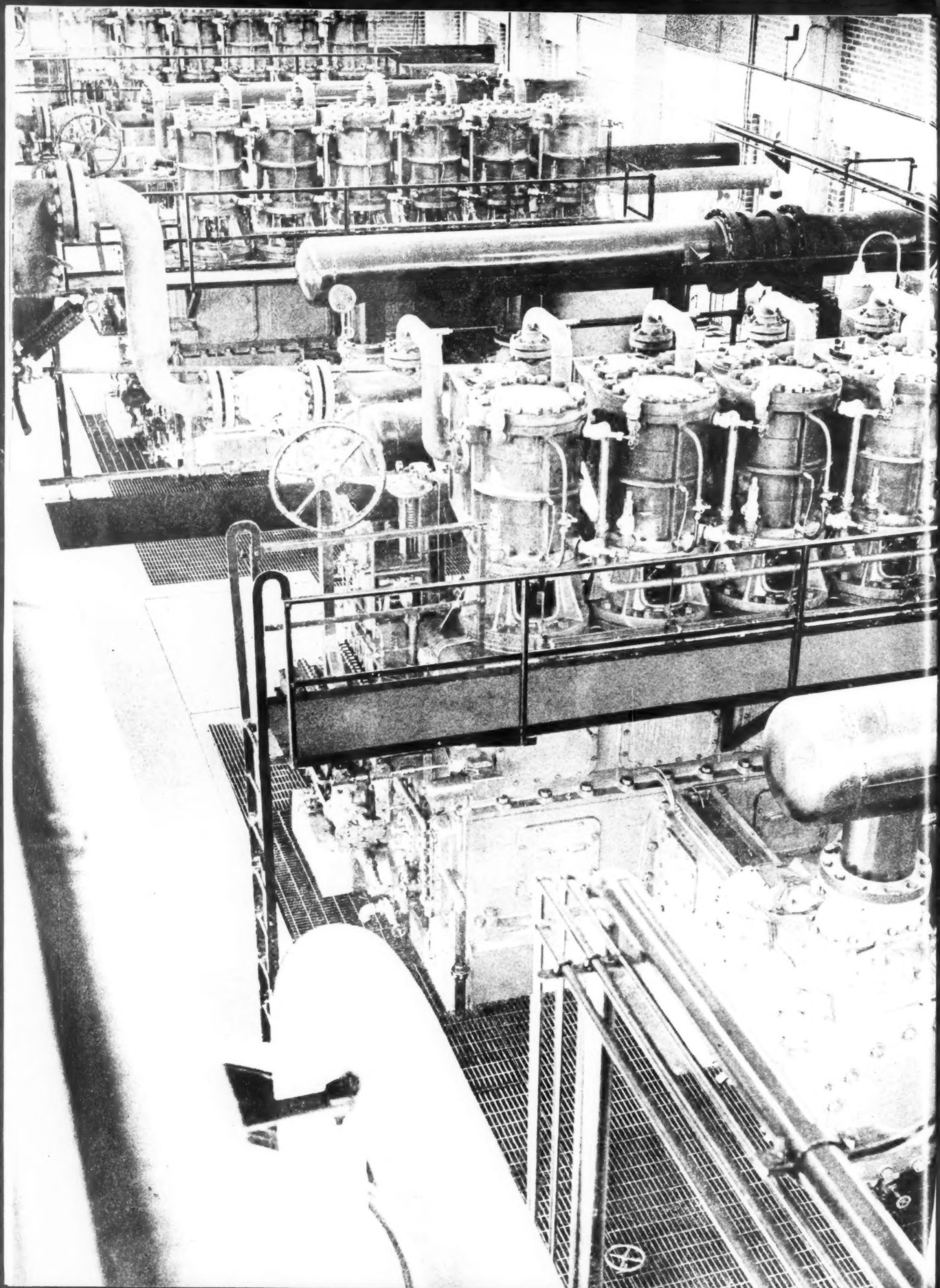
Left: Here the End Product—Synthetic Rubber—Emerges.

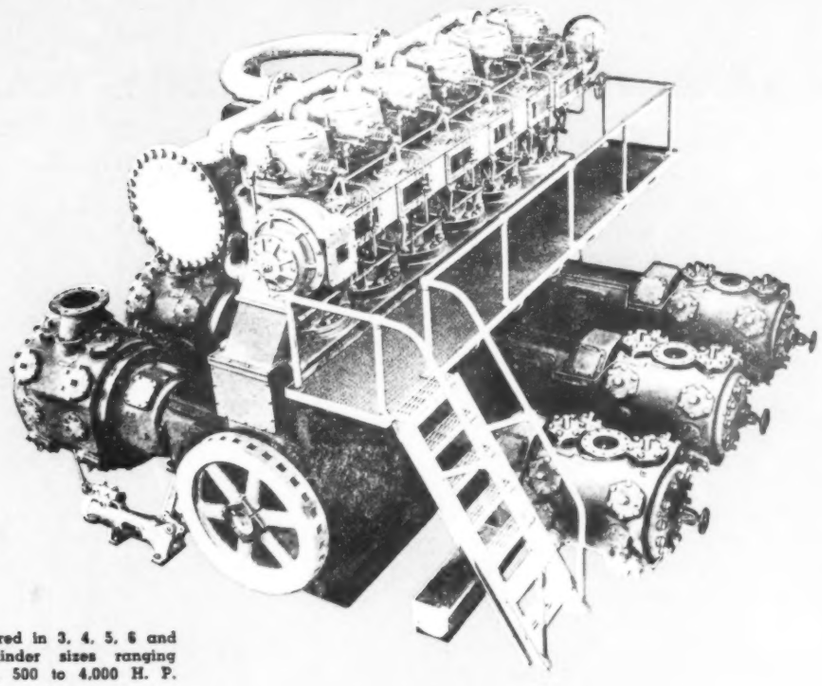
Below: Giant Stripping Columns of Goodrich Copolymer Plant.



ing, some of them reaching heights of 175 feet, and a total of 42 spheroid pressure-storage tanks, some of which hold 12,000 bbl.; this is said to be the largest number of such tanks ever assembled in one spot in the history of oil refining.

The finally purified butadiene is delivered to storage tanks, from which it is delivered by pipe line to two adjacent co-polymerization plants corresponding to the twin butadiene plants. One of these co-polymerization plants will be operated by B. F. Goodrich Company and the other by the Firestone Tire and Rubber Company. These synthetic rubber factories were built by the Defense Plant Corporation with government funds, and will be operated by the two rubber companies for the account of the Rubber Reserve Company. In this synthetic rubber manufacturing process, which has been fully described in other places, the butadiene is co-polymerized with styrene or ethylene benzene made from hydrocarbons that are also specialized products of petroleum refining. The styrene which is compounded at Port Neches with butadiene to produce GR-S rubber is produced at government owned plants operated by Monsanto Chemical Co., at Texas City and the plant of the Dow Chemical Company, at Velasco, Tex.





Offered in 3, 4, 5, 6 and 8-cylinder sizes ranging from 500 to 4,000 H. P.

Largest Butadiene Plant Uses Clark Steam "Angles"

10,440 B.H.P. IN PORT NECHES INSTALLATION

The world's largest Butadiene plant—Neches Butane Products Company, at Port Neches, Texas—will use CLARK steam-driven "Angle" Compressors to compress the series of gases which are handled in producing Butadiene.

The CLARK installation, part of which is here shown, will total six 6-cylinder 1740 B. H. P. units, or 10,440 H. P. These compressors will require 50 million pounds of steam daily for capacity operation, while the water cooling plant will handle 308,000,000 gallons of water per day, enough to supply a large metropolis.

This huge plant, operated by five major oil companies, will produce 100,000 tons of Butadiene annually, enough for 110,000 long tons of Buna S Rubber, and approximately one-seventh of the nation's requirement.

The CLARK Steam "Angle" offers the advantages of large capacity, small floor space, supreme fuel economy, low installation cost, low maintenance. It has established new records for operating economy. Our engineers are available for consultation without expense to you.

CLARK BROS. CO., INC. . . . ORLEAN, NEW YORK, U. S. A.

Export Office: 30 Rockfeller Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla.; Houston, Tex.; Chicago, Ill. (122 S. Michigan Ave.); Boston, Mass. (131 Clarendon St.); Huntington Park, Calif. (5715 Bicket St.) Foreign Offices: 72 Turnmill St., E. C. 1., London; Avda Roque Saenz Pena 832, Buenos Aires.

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CLARK

COMING YEAR CALLS FOR SUPREME WAR EFFORT

By William R. Boyd Jr.
Chairman Petroleum Industry War Council
President American Petroleum Institute

Army, Navy and Air Needs Are Rising to Higher Levels and Demanding Huge Quantities of Special Products—All-out Effort Needed to Make 1944 the Year of Victory.

As this country surges with grim determination into the decisive battles of the third year of World War II we are reminded that this destructive conflict has already outlasted World War I for both the United States, Great Britain and Russia. Only in the number of military casualties has this war been less costly than the last but this cost too will probably become appallingly heavy before Hitler's Fortress Europa is breached and taken and the last emblem of the Rising Sun is lowered in surrender.

I know that I speak the thoughts of every reader of World Petroleum, every oil man and every American when I express the solemn and sincere hope that the review of 1944 when made will be an account of complete and lasting victory for the United Nations.

When that review of victory is made and not until then can the full part of petroleum in achieving that victory be described. And not until peace has made possible an accounting of costs can the toll of war upon the petroleum industry be tallied. That the cost is already heavy and the sacrifices countless we already know.

On every hand we see and hear of depleted reserves of petroleum; of impoverished and defunct operations; of the death in battle of hundreds of future leaders of the industry; of the death and collapse of scores of our present captains of the industry whose overwhelming burdens have made them war casualties no less than those who went down with their ships or who were the victims of Axis shells and bullets, and of the loss of those who have been killed and injured in the drilling of wells, the building of pipelines, the construction of 100-octane plants and the carrying of oil through submarine infested seas.

Yes, this is an all-out war for the petroleum industry as well as for the nation. The cost in lives and health and wealth has been heavy by every test and will be even heavier as we come now to the grim and desperate climax of the war. Yet every oil man realizes, as every citizen and every government should, that since this is an oil war in which oil must ever be the fuel for freedom's flame, oil, too, must pay the price of victory which the vanquished will lose for lack of oil.

The year 1943 has witnessed the realization and sublimation of most of those broad plans and brave efforts which were initiated in the first fateful year after the shock of Pearl Harbor. The petroleum industry, in common with other essential industries, has risen to new productive heights in providing what it takes to make this a war of mobility and speed.

In the year just passed we have witnessed the Huns and Italians being driven out of all Africa; we have seen Sicily and part of Italy freed of the Nazi yoke; we have watched the slow but sure winning of the Battle of the Atlantic and the eclipse of the submarine; we have gained by the reopening of the Mediterranean; we have been thrilled by the inexorable eviction of the Reich armies from the Russian homeland; we have grimly rejoiced at the merciless pattern of retribution that MacArthur and Halsey have fashioned for the Japs in the South Pacific, and last, but by no means least, we have subscribed, paid for, and enthused over the greatest war machine this country has ever produced—the greatest army we have ever had, the mightiest navy in the world, and an air fleet that rules the skies.

We know beyond dispute that not one of these great milestones on the road to victory could have been achieved without petroleum. What is more, the enemy knows it too, and the warlords of Hitler and Hirohito face a certain, but none the less dismal future by reason of that knowledge. In this case knowledge of petroleum without its possession is not power, but rather, is sure defeat.

In making possible the "end of the beginning" and in hastening "the beginning of the end" in 1943, the petroleum industry of America, in partnership with the United States Government, represented by the Petroleum Administration for War, headed by Secretary Harold L. Ickes and staffed largely by oil men contributed by the industry, has blazed a bright record of achievement in all directions save two. It was not able to supply enough oil to meet all civilian demands after meeting military requirements and for the fifth year in succession it failed to find enough new oilfields to replace the oil that is being produced in such prodigious quantities from our old oilfields.

Although notable progress has been made through congressional action and with PAW support in furthering the plea of the petroleum industry for a commensurate price for crude oil and its products—a price which will provide the incentive necessary to encourage exploration for new petroleum reserves and the maximum recovery of known reserves—success in this endeavor, though seemingly assured, had not actually been attained as the year ended.

For the most part the American people have taken an understanding and cooperative attitude toward the shortages of gasoline, kerosene and fuel oils that have resulted in varying degree from the demands of war which have increased faster than has the capacity to supply. All the inconveniences and hardships of rationing, crowded and curtailed transportation and actual shortages of food, clothing and other essentials have been taken in stride by our people, particularly those who want to do their utmost to bring safely and quickly home their sons and daughters, husbands and wives, fathers and mothers, who are now engaged in forging and fighting with the tools and weapons of victory that are fashioned and fueled with petroleum.

Here on the homefront the principal accomplishments of the petroleum industry may be baldly stated to have been:

1. The drilling of approximately 18,650 new wells for oil and gas, of which about 15,500 were

Captains of The Industry—Government Oil Team.

development wells and about 3,450 were exploration wells which, if the discovery rate of the first ten months continued to the end of the year, probably uncovered something over 500 new sources of oil.

2. The construction and completion of two "Big Inch" pipelines from Texas to New York and 14 lesser but none the less important pipeline projects to aid oil transportation.

3. The completion or near completion of 72 new plants for the production of 100-octane and other military gasolines, lubricants and explosives, and for the production of butadiene for synthetic rubber. In a few months now 122 of these vast new plants will be supplying more than ten times the amount of 100-octane gasoline that was available at the time of Pearl Harbor and in conjunction with the alcohol butadiene plants will comfortably supply enough synthetic rubber for all military and civilian demands.

4. The adjustment of industry operations so as to do more and make more with less manpower and fewer materials and to deliver military requirements on time and as needed while maintaining adequate civilian distribution in the face of almost every possible handicap.

Plain figures tell the story of the drain on our oilfields which in January 1943 actually produced 4,012,200 barrels daily of petroleum but which are called upon by PAW for 4,707,150 barrels daily for January 1944, an increase of 14.5 percent in one year. The state of Texas, which is America's great but not inexhaustible storehouse of oil, has been called upon to supply 2,018,000 barrels daily in January 1944 as against 1,421,800 barrels daily produced in January 1943, an increase of 596,200 barrels daily, or 42 percent. On the other hand, PAW has allocated only 1,117,000 barrels daily of gasoline for civilian consumption in the first quarter of 1944, a decrease of 38 percent from the peacetime 1,800,000 barrels daily available for civilian use.

At the twenty-fourth annual meeting of the American Petroleum Institute at Chicago in November, 1943, many pertinent facts regarding the use of petroleum in war were first revealed by the noted speakers on the program. Some of the more arresting of these facts may be here repeated:

Gasoline needs in this war already are 80 times greater than in the last war.

It takes nearly three pounds of gasoline to deliver one pound of bombs, filled with petroleum explosives, on an enemy objective.

Every American soldier overseas requires an average of more than 50 gallons of petroleum products per week, with the oil used by navy and supply ships and America's allies boosting the consumption of oil per soldier to a higher figure.

Every oil well in the U. S. now must produce each day an average of three barrels of oil for war, and may soon have to produce four barrels for combat purposes.

More than fifty million gallons of gasoline, fuel oils, lubricants, and other petroleum products are now going directly to the fighting forces every day.

Sixty-five percent of the total tonnage of overseas shipping for the prosecution of the war consists of petroleum products.

Current studies show it is four or five times as difficult and costly to find a barrel of new reserves today as it was in the pre-1938 period.

The gasoline supply for the motorist in 1944, on the basis of present military estimates of demand, cannot be greater, and may well be less.

Hitler and Hirohito are doomed because they started a war they could not win because of lack of oil.

This country is producing four times as much 100-octane gasoline as it did in December, 1941, and current output will be doubled in a few months. But more oil is needed as the nation produces more bombers, tanks, and other mechanized weapons.

Without oil, all the rest of our enormous war production program could not succeed in destroying the enemy as he must be destroyed.

Oil is the ultimate yardstick of accomplishment in modern warfare.

Since July 1940 we have produced more than 28 billion rounds of small arms ammunition—enough to let us fire about 2,000 bullets at every Axis soldier.

To date we have produced more than 1,600,000 tons of aerial bombs.

Six hundred thousand barrels of gasoline per day —one-third of our total production—are being taken by the military.

Our military requirements, every day, are equal to the gasoline that could be bought on 12 million "B" coupons.

Since July 1940 this country alone has produced more than 140,000 military airplanes. Last month we produced 8,362 planes, which represents a rate of 100,000 planes a year.

In October (1943) we made three times as many 4-engined bombers as we made last January. And we have not yet reached the full limit of our production possibilities in any of these capacities.

Since July 1940 we have turned out more than 30,000 ships of various sizes, in which are included small craft and 2,400 ocean-going dry-cargo vessels and tankers—a total of about 25 million deadweight tons. Also included in this figure are almost 600 combat ships of our navy.

In the past three years we have produced about 1,300,000 motor trucks for our armed services and lease-lend, with large numbers of trailers and other automotive equipment for ourselves and allies—consuming tremendous quantities of gasoline. These 1,300,000 trucks are about the equivalent of one-fourth of the entire number of trucks now operating in the entire U. S.

Since the middle of 1940 we have made more than 50,000 light and medium tanks, with very large numbers of armored cars, scout cars, carriers, and other types of self-propelled equipment —all burning gasoline.

When the Japanese struck at Pearl Harbor, there were only 22 refineries making 100-octane gasoline. When the current program is completed, there will be six times that amount.

In the two-day bombing of the Japanese at Wake Island, October 5-6, 1943, our planes alone used enough gasoline to give 150 average American motorists their normal peacetime supply of gasoline for one year.

To keep in the air for one hour the Navy's fast new fighter plane, the Hellcat, which took part in the engagement, requires as much gasoline as to drive a car on a 3½-day trip from Chicago to Los Angeles. A single Hellcat uses up that much gasoline in the time it would take to play nine holes of golf.

The air forces are using high-octane gasoline in a quantity equal to the entire motor-fuel consumption of the armed services on the ground, or the entire fuel-oil consumption of the Navy afloat.

This year (1944), the Navy's needs for diesel oil will be 2,300 per cent of its 1941 needs, and fuel-oil needs will be 500 per cent of our 1941 consumption.

Military uses are taking more than 30 per cent of the gasoline east of the Rocky Mountains, and much more than 40 per cent in the Rocky Mountain and Pacific Coast areas; and these percentages will rise to 37 and 52 per cent in 1944.

Final plant capacity of the U. S. and Canada for synthetic rubber is estimated at 850,000 long tons, and plants completed to October 31, 1943 give us a present operating capacity of 646,000 tons.

When we went to war with the Huns 25 years ago an average division had about 4,000 horsepower. For those days that was good. Today that same division has almost 200,000 horsepower, 50 times as much, and it is still growing.

Our navy used 26,000,000 barrels—not gallons—but barrels of oil during 1942. It has been esti-

(Continued on page 62)

CRUDE OIL PRODUCTION—WHERE WE STAND TODAY

By D. R. Knowlton
Director of Production Petroleum Administration for War

FOR the first time in almost two decades the petroleum industry is entering a new year with the full knowledge that the nation's ability to produce crude oil is not adequate to meet the ever-growing requirements—requirements which have been curtailed to the practical minimum by civilian rationing and conversions to other sources of fuel and power.

When this country entered the war few people would countenance the notion that crude oil productive capacity could be a limiting factor in any of our war plans. Complacency about our crude oil supply situation has been jarred by two factors. First, petroleum requirements for supplying the Army and Navy and the tremendously increased industrial activity have soared to a record high figure. Second, as the production rates of our oil fields have been increased to meet these higher essential requirements the ability to produce has not been sustained as well as petroleum engineers and practical production men had generally anticipated. At today's production rate of over 4,400,000 barrels of crude oil per day, every oil producing area in the United States, except West Texas, is producing at or in excess of its maximum efficient capacity. When pipelines now being constructed from West Texas are completed this area too will be called upon to produce to its highest efficient limit.

As I reflect on the year 1943, two bright spots stand out. The Tensleep Horizon at Elk Basin, Wyoming, though a 1942 discovery, has developed during 1943 into the largest oil pool since Hawkins. This also points to possibilities of other sizeable reserves in the Tensleep Horizon on other known Rocky Mountain structures.

The second bright spot is the high drilling activity undertaken by the industry in response to PAW urgings to complete rapidly the development of the numerous known multizone fields in California. Well completions in California are at a higher level today than at any previous time.

The discovery of oil in Florida, the success in the Ellenburger Lime of West Texas, and the improved exploratory results in Oklahoma are also encouraging happenings of 1943.

The objective of the producing branch of the oil industry for 1944 is clear. Everything must be done to augment the nation's ability to produce crude oil. This means we must: (1) find and develop new oil fields, (2) properly complete the drilling of those we now have, and (3) apply the most advanced production techniques in order to secure maximum output from our known fields. For 1944 we are planning on a well drilling program of 24,000 wells and we are urging that 5,000 of them be wildcats which is some 1600 more exploratory wells than we have ever drilled in any year to date. We are hoping that as the year progresses the materials situation, the availability of manpower, and economic conditions will justify the expansion of our program of development well drilling. Naturally, we hope that exploratory activity will be greatly expanded and will uncover fields in which we can drill an even larger number of development wells during 1945.

If our experience during 1944 is comparable to our experiences during recent years the drilling program outlined above will barely offset the normal decline in productive capacity and permit us to maintain production at 4.4 to 4.5 million barrels per day. As oil men, we naturally hope for a strike of such significance as to explode this depressing viewpoint, but we dare not place too much trust in our hopes. Even if we are successful in maintaining domestic production at current rates we will, nevertheless, be short of oil. What is still more significant, even if our 1944 discovery record should be equivalent to the best year in history our fields would still be sorely taxed to meet all the growing requirements for crude oil.

It will be necessary to import increased quantities of foreign oil in order to utilize fully the refining capacity in the United States and to maximize the production of aviation gasoline and other petroleum war products. Logistics and security dictate that the oil be brought to the refineries existing in the United States. This must be done if we are to meet the military and other essential needs for petroleum products.

But imports will only lessen our shortage. Limitations of transport facilities as well as of foreign productive capacity will preclude the possibility of fully relieving the shortage.

The shortages in materials and equipment which have made necessary certain restrictions on operations have been lessened and we expect to improve the situation still further during 1944. We are not, however, out of the woods by any means. Whereas a year ago the steel was not available to permit unlimited production operations, this year's limitations in mill capacity for the fabrication of pipe and for the manufacture of component parts of oil field equipment constitute our major obstacles. The War Production Board Controlled Materials Plan has provided a framework for bringing about the general improvement thus far, and I am satisfied that as the year 1944 progresses this improvement will continue. The Production and Materials Divisions of PAW will continue to function as a clearing house for eliminating any bottlenecks which may arise to interfere with the completion of our program for 1944.

The manpower problem which has been so troublesome up to this time should be less vexatious during 1944. This does not mean that the over-all manpower shortage is any less acute, but rather that more intelligent handling of manpower problems through the cooperation of the War Manpower Commission, Selective Service System, the United States Employment Service, the Petroleum Administration, and the petroleum industry has resulted in establishing the petroleum industry with a high priority on manpower. Thus, the drain on the industry's personnel from other war industries and by the armed forces, has been arrested.

I expect the year 1944 to bring to the Production Division and to the production branch of the industry as many problems as ever, but I anticipate more cooperation and assistance in their solution. Whereas we entered the years 1942 and 1943 with many people believing that our warnings of an oil shortage were merely cries of "Wolf," there are few people, if any, today who do not appreciate the seriousness of the shortage and who are not willing to assist in solving the problem.

Illustrative of the assistance and cooperation now being extended to PAW is the working arrangement recently completed with the Army-Navy Petroleum Board. Many manufacturers of oil field equipment find themselves unable to meet oil country needs because large portions of their plants are devoted to ordnance work. Through ANPB, arrangements can be made in many cases to transfer the ordnance work to other plants, making it possible for oil equipment manufacturers to resume full essential production for oil field use. In one case government owned machinery was made available for relieving a particularly distressing shortage in one very important item.

The slight decline which production in the Appalachian Region, PAW District 1, has experienced during the past two years will probably continue during 1944. That this district does not decline more rapidly is attributable to continued application of secondary recovery, particularly waterflooding in the Bradford area.

The Mid-Continent area, PAW District 2, which now produces about 940,000 B/D will decline about 100,000 B/D in productive capacity unless some important new discoveries are made in the district. District 3, the Southwest, which produces over half our crude oil requirements will probably hold steady at about two and one-half million B/D. The additional oil to be made available by the pipelines now being built into West Texas, combined with the new production being developed throughout the district by the current drilling should offset the decline in the older fields in this district. The Rocky Mountain region, PAW District 4, which in the past five years has doubled its production so as to reach 120,000 B/D will continue to increase its output due principally to additional development in the Elk Basin field. It seems likely that 20,000 to 30,000 B/D additional sustained capacity will be developed in this field alone by the end of 1944.

The Pacific Coast area, PAW District 5, which since the war, has increased production from 600,000 B/D to 800,000 B/D should be able to increase its productive capacity only slightly. A continued high rate of drilling, concerted efforts on the part of the industry to rehabilitate old wells, and the application of improved techniques to old fields are expected to offset the normal decline.

A critical situation exists in the Pacific Coast area with respect to crude oil supply. In spite of the already increased production and the slight further increase anticipated for next year the requirements are outstripping and will continue to outstrip supply. Stocks of products are being drawn upon at a rate which cannot long be maintained. It is not possible to offset this deficiency with other domestic production and it will have to be met from sources outside of the United States. This will be one of the most serious problems confronting PAW during the coming year.

It is incumbent upon the Petroleum Administration and upon the industry to do everything possible not only to maintain domestic production from known fields but to augment it by the further adoption of secondary recovery and pressure maintenance projects wherever practicable. These forms of production operations will not only maintain higher rates of current production but will also result in higher ultimate recoveries.

Reference to secondary recovery and pressure maintenance immediately introduces the need for legislation in the several oil producing states which will assist the operators in accomplishing the consolidation of their interests where necessary in order to make possible the application of the most modern forms of reservoir control and operation for the recovery of petroleum from oil fields. The Interstate Oil Compact Commission is evidencing a lively interest in the need for improved conservation statutes, and I believe that the year 1944 will see that body and many of the industry trade associations giving increased attention to the problem.

There is no room for optimism in the 1944 oil picture. Success in wildcatting beyond our rosiest hopes will still leave us short of oil. The situation is such that even long chances are justified. I hope, therefore, that the year 1944 will see many random wildcat wells drilled. Geophysical search is uncovering the smaller pools overlooked by earlier methods but for sustained relief we must resort to real "wildcat" drilling in the untested sedimentary regions and in areas where geophysical methods are not adaptable.

While I share the hope that the year 1944 will see the termination of hostilities, such hope must not deter us in our efforts to increase our crude oil productive capacity. Operators must not taper off in their activities. We must continue to find, develop, and produce crude oil in larger and larger quantities.

REFINERIES WILL WORK TO LIMIT OF CRUDE SUPPLY

By E. D. Cumming

Director Division of Refining Petroleum Administrator for War

All Available Materials Going into Completion of 100-Octane Program—More Capacity Needed for Essential Civilian Requirements—Seek Increase in Kerosene Supply.

ONE major problem facing the refining industry as we round into another year of war is to get 100-octane aviation gasoline plants into operation. Every effort is being made to push the remaining construction to completion. According to present schedules the plants now building should be finished and get into operation early in 1944.

In order to speed up the completion of vitally needed 100-octane gasoline plants, PAW is making use of every bit of available excess material and equipment that can be found. The Army is helping in this endeavor by furnishing lists of materials made available due to the cancellation of Army Ordnance projects after the material had been ordered and manufactured for these cancelled projects.

Refiners and contractors can thus speed up construction of plants by special refining units by obtaining new material and equipment that has been declared "excess and available for war plants."

There are numerous "excess" materials stock piles throughout the country. Two of the larger stock piles of these items, in universal demand by refiners, have been accumulated in Houston, Tex., and Los Angeles, Calif. At present the materials are available only to refiners building aviation gasoline plants.

The 1942-43 program called for 72 major plants, 32 of which are now operating and the remaining 40 being scheduled for operation during the next three months. In 1944, if our war demands are to be met, 22 more plants will have to be built on schedule. Utilization of existing equipment wrote the specifications for most of the 94 major 100-octane construction projects initiated by PAW.

Base stocks for manufacturing 100-octane still is a problem, and the job of obtaining them in sufficient quantities in all likelihood will remain so throughout the whole program. Procurement of ample supplies of base stocks will present the most headaches during the first months of 1944.

This will necessitate trimming some corners in our use of base stock. Part of the deficiency can be made up by using lower grades than 100-octane in training planes. We need all the aviation gasoline we can get—combat and training—

E. D. Cumming

and the 80-octane for the ground forces, and the increased production of these military necessities has brought into the fore a serious problem.

Refiners who possibly could do so have gone in so strongly for 100-octane and ground force gasoline that they are handicapped by having little or no production capacity available for turning out enough gasoline for civilian requirements. There is a need for some means of freezing the civilian gasoline refiner in production and not pushing him out of the market. This is not an economic question for presently he is making a profit out of his refining operations. He should, however, have some assurance of being in the picture in the post-war period.

A sort of Directive 59, nation wide in effect, is needed to protect his marketing position and reserve his place in the after-war economy. High demands for military production are wiping him out of the civilian picture.

This situation in refining setup is true of the refiners in California. Refiners there have exhausted the last ounce of their civilian gasoline capacity and have greater need of utilizing their facilities for keeping up the civilian supply.

Another consideration is that we will have to run more crude in 1944 than ever before. Every refiner in all districts, with the possible exception of those in District 2, must run every barrel of crude he can get his hands on in order to meet production goals. Refineries will run at capacity in Districts 1, 3, 4, and 5. District 2, however, will be short of crude.

The ceiling price structure won't let District 2 refineries run crude from West Texas. At least that would be so normally. But the recent arrangement announced by RFC Chairman Jesse Jones to permit Defense Supplies Corporation to pay excess transportation costs on "sour" crude from West Texas to District 2 was designed to ease the burden with respect to refiners in that territory.

We have reached a stage where the war is so vital that productive demands on refiners for all military and industrial products, considering the limitations of our supplies of crude, leave civilian supplies as our only cushion. At the moment civilian use of gasoline is taking about 25 percent—1¼ million barrels—of our crude output a day. Half of this goes into gasoline for truckers, doctors, and such essential civilian needs.

Any pinch necessitated by increased demands for the military will have to come out of civilian gasoline.

The "cat" crackers building throughout the country will process a high quantity of raw materials. For the most part these "cats" are at refineries where raw materials are being manufactured. Increases in their output will not upset the national program because we are going to run more crude.

Current estimates are that we will process about a million barrels more of crude a day. Some refiners who never produced kerosene will be producing it, and the outlook is for no shortage of intermediate distillates.

Under stress of demands for war products—aviation gasoline on the one hand and heavier products on the other—kerosene yields have been —and are—suffering as a result of modern wartime refinery methods.

PAW is pressing, however, for increased production of kerosene. Refiners have been asked to step up to the fullest kerosene yields wherever possible without sacrificing war products. We have definite indications that this will be done. We are exploring the possibilities of changing kerosene specifications so that those refiners who now cannot meet requests for greater yield will thus be able to do so. We are also considering possibilities for using other grades of fuel oil in substitution for kerosene wherever this can be made feasible.

The government has removed all flexibility from refining operations, because the refiner's facilities have been frozen to the maximum 100-octane aviation gasoline he can produce. Not what the sales department says can be handled with an eye to commercial possibilities and the markets, but what the government says is needed for the military effort.

Industry has been slow to recognize this.

OIL INDUSTRY FACES CRUCIAL PERIOD IN 1944

(*Continued from page* 31)

sure that the Marines at Tarawa, as they waded shoreward through machine gun fire, would have liked to shake off discipline, too, and go back to their transports—and relax. When we consider what they did there, is our responsibility not clear? Surely it must be. I said to the American Petroleum Institute at its annual meeting in Chicago in November:

"How far from final victory we may be in this war no one can know. But, whether the distance be short or long, the fact that we must exert ourselves to the utmost—all the way—until victory is achieved, is still the fact. In the course of battle such as being waged today, there can be no let-up until there is decision. Every week, every day, every hour counts. And so I would emphasize . . . above all else, that we, each and every one of us, be reminded and remind others continually—of the need to go on without let-up, go on with that vigilance, that devotion to duty, that determination to win—which means victory for our side in the shortest space of time and with the least loss of human life."

This is still my plea to the American industry. So long as the conflict continues we must face problems of great challenge. But the industry has been put to the test before, and I am unwilling to believe that it has lost the strength, the ruggedness, the resourcefulness, the ingenuity, the intelligence and the courage which have carried it through the crises of the past. I believe, instead, that it has grown in all of these qualities, and that it will not only do its job superbly, right through to the end—including the final thirty seconds—but that it will come out of this war a stronger, better, more enlightened industry than it has ever been before.

PROPOSE FOREIGN OIL POLICY FOR UNITED STATES

In Report to Petroleum Administrator the Foreign Operations Committee Recommends Reliance on Private Enterprise to Expand Activities in Other Lands.

THE Petroleum Administrator for War has made public a report submitted to him by the Foreign Operations Committee outlining what the Committee considers to be a suitable foreign oil policy for the United States. The Foreign Operations Committee is an industry committee composed of 31 prominent oil men who have had extensive experience with oil enterprises in foreign lands. Orville Harden of the Standard Oil Company of New Jersey is the chairman and A. G. May of the Socony-Vacuum Oil Company is executive secretary of the Committee.

The report emphasizes the fact that as the result of world developments the United States has an inherent interest in the assurance of peace and economic stability in the post-war world and must be concerned with the promotion of measures for facilitating and smoothing the necessary expansion of the world's petroleum industry, without which world peace and orderly economic relations will be more difficult of attainment. Long an oil exporter on balance, the United States must now face evidence of an imminent shift from a condition that allows of surplus oil for export to a condition wherein the nation will become a net importer of oil. This expected change will make the oil economy of the United States partly dependent upon foreign oil resources. It is important that this dependence be as free as possible from insecurity and uncertainty.

The committee maintains that the United States can best safeguard its essential interest in foreign oil by a policy which will encourage American capital and American enterprise to assist in locating and developing hitherto undiscovered oil resources in foreign countries, particularly in the Middle East and in the Caribbean area, which together are reputed to contain more petroleum than all the rest of the world put together. If it is admitted that the United States must look abroad for a supplement to its oil supply, the agency which is to find and bring in foreign oil must be either the government itself, or private enterprise, which has already shown itself competent for the task.

There are some weighty arguments against the idea that the government should enter the foreign oil business through the agency of a government-financed and controlled corporation which would acquire ownership of foreign oil properties, or controlling interests in foreign oil corporations. It is pointed out that really to serve the essential foreign oil interests of the United States such a corporation must be prepared to do a world wide business. Oil operations involve exploration, production, transportation, refining and distribution. A government entering the oil business in one foreign area will soon find itself extended, directly and indirectly, into a far flung complex of international complications transcending the original locus. Another circumstance which should not be overlooked is that many countries not only resent but prohibit the holding of natural resources by an alien government either directly or indirectly, while permitting private capital to operate freely. Government enterprise in foreign countries may thus prove a handicap in time of war, as recent experience has demonstrated.

From its consideration of the whole problem the Committee reaches the conclusion that the government should stay out of the foreign oil business and rely on American private enterprise to bring in the foreign oil needed to supplement our native reserves. The arguments in favor of relying on private enterprise are many and impressive. In the first place, private capital is not viewed by foreign governments in the same light as the state capitalism of an alien government. Private operations thus reduce the political dangers inherent in the international field. Private enterprise is the best judge of the soundness of a foreign enterprise; it is the best source of the venture capital required for the undertaking, and it can best supply and develop the requisite managerial and engineering techniques. The proficiency of the petroleum industry of the United States is an invaluable agent for promoting post-war reconstruction and industrial advancement throughout the world. In the skill of its own nationals in oil development the United States possesses an asset of inestimable value not only to this country but to all other countries. This asset only needs a suitable national policy to be galvanized into a powerful force for world reconstruction. Private American enterprise has already demonstrated its ability in international oil developments. Operations of United States oil companies are at present well-nigh worldwide in scope. This world-wide spread is a major factor in effective national defense in the matter of petroleum supply and will be a major factor in facilitating peaceful commerce. To enhance national security it is necessary that many and widely distributed sources of products for military supply should be in the hands of United States nationals. Such sources have been developed by private industry and in many cases can only be so developed. Government capitalism is hardly competent not only to secure these supplies but would be hard put to create the necessary distributing facilities as well.

In the matter of foreign oil supplies the government should, therefore, stay in the background and encourage private American enterprise to engage in the development of oil resources abroad, and the foreign oil policy of the United States should be shaped so as to obtain for American nationals freedom of action in foreign fields at least on a footing of equality with the nationals of other countries.

There are many risks in the oil business anywhere, and in addition to natural risks there are political risks in international business. The United States can serve the interests of its nationals and at the same time promote the interests of foreign countries by a foreign policy designed to reduce the political risks involved in foreign oil business. The diplomatic support accorded to our nationals should be as effective as that accorded to nationals of other countries by their respective governments. Even with equal access to oil reserves assured to United States nationals, such theoretical equality will be illusory unless our government will insist that acquired rights be respected. At the same time it should be remembered that in conducting business in foreign countries which have economic and legal concepts different from ours, United States interests must conform to the laws and customs of the countries in which they operate if they are to do business there on an equal footing with foreign competitors. Until United States laws designed to promote the welfare of our own country clearly authorize American interests to compete abroad on an equal basis with foreign industry, American business in other countries will be handicapped and American foreign trade will correspondingly suffer.

The Committee's report ends with a recommendation that since a large part of the world's known oil reserves are owned, controlled or under concessions held by nationals of the United States and Great Britain, these two countries should take the lead in achieving an international agreement on the basic principles outlined above. It is said that this international agreement might well be modeled after the Interstate Oil Compact which is now in effect in the United States. Within the United States this compact does not oust the individual States from control of their own oil policies; similarly, each foreign country would be left in freedom in its own oil policy. What our Oil Compact does is to assure the coordination of the policies of the various states; similarly, the oil policies of various countries are in need of coordination.

This international coordination should be directed to reconcile the interests of different nations in terms that will best serve the interests of world peace and economic advancement; to abate as much as possible the reduction of oil consumption by excessive duties and taxes; to assure practical equality of all interests; to modify restrictions that unnecessarily hamper the development of needed oil reserves; to promote efficient development of oil fields by the most advanced engineering practices, and especially by implementing the concept of the optimum rate of production so as to avoid irreparable waste; and institute a coordination that will prevent the accumulation of stocks by aggressor nations.

★ ★ ECHOES FROM THE WASHINGTON OIL FRONT ★ ★

By W. J. Maddox, Chief of World Petroleum's Washington Bureau

Sees 500,000 Bbl. Deficiency

Ralph T. Zook

RALPH T. ZOOK, the new president of I.P.A.A. before the Lea oil investigating committee the other day, exploded the fallacy that you can divide the total amount of known reserves by current annual production and the result will be the number of years our underground supply will last.

"No greater misstatement can be made," Zook asserted, "but it has been and is even now being made time and time again by those who should and do know better."

Some of the oil reserves, he explained, away back in the small spaces in the sand cannot be produced for from 75 to 100 years from today.

"To say that there are 20,000,000,000 barrels of oil in the U. S. only lulls the uninformed into a feeling of complacency and confidence that the nation's oil supply is ample," declared the new I.P.A.A. president. What should be said is that during 1944, the estimated total domestic ration requirements and military demand will by the fourth quarter equal 5,219,000 barrels daily and the total foreseeable supply from all sources within the U. S. including crude oil, natural gasoline, condensate, distillate and benzol, together with withdrawals from crude and products stocks, is 4,703,000 barrels daily and there will be a deficiency of over 500,000 barrels daily."

That is something that can be understood. The true test of today's and tomorrow's and the next year's oil supply is the ability to produce—to bring this oil to the surface of the earth and make it usable in the form of gasoline, fuel oil and lubricants as well as the hundreds of other products which are being made from petroleum—not forgetting synthetic rubber.

Companies Liquidating Capital

ZOOK also took a shot at Economic Stabilizer Fred Vinson's argument against a crude price increase that oil companies are making money at present prices. He had canvassed a number of the companies who have shown book profits for the first six months of 1943 compared with the same period 1942. Boiled down the answer given by the companies is that they are taking crude out of the ground at prices below replacement cost today.

As for his own company Zook said, in spite of showing more book profit this year than last, it is "going out of business". It cannot acquire new reserves to be sold profitably at today's price of crude oil.

Two Divisions Consolidated

DISCONTINUANCE of PAW's Reserves Division and the merger of its work and personnel with the Production Division leaves Don R. Knowlton, Director of Production, in charge of the consolidation. William B. Heroy, who had previously served as Director of Reserves, last month assumed directorship of the Foreign Production Division.

Explaining the consolidation, Deputy Administrator Davies said:

"Within the past year, the functions of conservation and exploration, which were performed by the Reserves Division, have become a controlling part of the whole job of producing crude oil. It is our conclusion that supervision over PAW's activities with respect to conservation, exploration, and crude oil production can best be exercised by placing these responsibilities in one division.

"The consolidation does not release personnel; we have little enough staff as it is, considering the proportions of the job to be done."

Wilson Heads Transportation

George A. Wilson

GEORGE A. WILSON, new director of PAW's Transportation Division, succeeding Jubal R. Parten who resigned to return to private business, has been executive officer of the division since joining PAW in April 1942. He is on leave from the Standard Oil Company of Louisiana, where he headed the production, and pipeline department at Shreveport.

In announcing the appointment, Deputy Administrator Davies pointed out that Mr. Wilson since coming with the agency has worked closely with Major Parten on all phases of oil transportation—pipelines, tank cars, barges, lake tankers and tank trucks. Because of this experience, Mr. Davies said, the new director is regarded as well qualified to carry on the job that Major Parten has directed through the emergency period.

Born February 1, 1910, in the Louisiana oil country, at Mansfield, Mr. Wilson attended public schools there, was graduated from Centenary College, Shreveport, in 1929 and received his law degree from Tulane University in 1933.

During the years 1933-40, Mr. Wilson maintained a private law practice in New Orleans as a specialist and consultant on oil and gas, and during this period he served as part-time professor of oil and gas at Tulane University Law School. In 1940 he was appointed general counsel to the Louisiana Conservation Commission and to the State Department of Minerals. He aided in the reorganization of these two agencies. He joined the Standard Oil Company of Louisiana in July 1941 and also served as a director of the Mid-Continent Oil and Gas Association up to the time he joined the staff of PAW.

Parten Returns to Texas

Maj. J. R. Parten

MAJOR PARTEN will resume his activities as president of the Woodley Petroleum Company of Houston, Texas and chairman of the board of the Premier Oil Refining Company of Longview, Texas.

Expressing "sincere regret at Major Parten's departure," Administrator Ickes said:

"When we induced him to come to Washington, the Petroleum Administration and the Office of Defense Transportation faced the responsibility for working out, with the oil and transportation industries, the complete rebuilding of the oil transportation system in order to make up for the loss of ocean tankers that had been bringing the East 95 percent of its oil. The problem was so acute and so formidable that there were many who doubted that it could be solved as long as the war lasted. But, in twenty months, it has been virtually solved, and I do not know of any individual who has worked more tirelessly or more effectively than Major Parten in bringing that solution about."

Major Parten was called to Washington in August 1941 as a member of the then newly-created Tanker Coordinating Board, a joint government-industry organization set up by PAW (then Office of Petroleum Coordinator) and the United States Maritime Commission to coordinate the operations of American oil tankers. He was also one of the original members of the PIWC, resigning from that body in April 1942 when he was appointed PAW's Director of Transportation.

Large Imports Needed

By spring the petroleum transportation problem within the U. S. will be close to being licked, according to PAW Ickes, but domestic production will fall short of 1944 requirements. Imports, greater than in pre-war days, will be necessary.

"Upon completion of all projects (transportation, including pipelines) now under construction," the Petroleum Administrator said, "in the spring of 1944, the East Coast will have an overland capacity of about 1,625,000 barrels a day, and sufficient transportation capacity will be available throughout the country to distribute, with only a minimum use of ocean tankers, the total volume of petroleum that can at that time be produced within the United States to destinations where it will be required during 1944.

"However, United States production will not be enough during 1944 to meet the indicated total requirements and it will be necessary to use tankers for importation of additional petroleum. It is estimated that before the end of 1944 such imports will exceed pre-war imports."

Middle East or South America

Russell B. Brown

PAW Ickes article "We're Running Out of Oil" in the current issue of American Magazine brought a mild chiding of the author's foreign oil policy from Russell B. Brown, general counsel of I.P.A.A.

"The author appears to limit his interest in foreign resources to the Near East and the Middle East, to which region he says the 'capital of the oil empire is on the move'," Brown observes. "Scant mention is made of South America, whose proven resources are large and whose potentialities are considered to be of the highest importance. As South America is normally looked upon as the country whose petroleum would be most readily available to the U. S., it is odd that it should have been overlooked by Mr. Ickes, especially as it has been governmental policy to encourage close economic collaboration with Latin American nations.

"The only explanation that occurs to me is the fact that he was discussing the countries where the Petroleum Reserves Corporation (of which Mr. Ickes is president) might obtain a foothold, and certain South American countries oppose development of their resources by companies in which another government owns any interest."

Brown voices a sentiment that has been current in the industry for some time. The attitude of "certain persons in government," according to Brown, is one of permitting the supply from our own resources to decline through lack of effort, and to rely upon the hope that somewhere in the world, somehow, the needed oil will be produced and brought to our markets.

May Reopen Arabian Deal

PRC President Harold Ickes, in spite of the breakdown in negotiations early in November, hasn't given up hopes of acquiring an interest for the government in California-Arabian's Middle East operations. Although the negotiators parted, the door was not slammed tight, and Ickes is understood to be seeking a resumption of the discussions. He is willing to "resurvey" the government's position, which was that the company's terms were a bit stiff. The company is represented as having no objection to reopening the subject, and a resumption of negotiations can be looked for as a probable early development.

PRC's oil mission headed by De Golyer should be in the Middle East about now going over likely sites for starting foreign developments. One of the top executives of the oil company also is reported to have departed for Saudi Arabia. Ickes's efforts to acquire interests in going foreign operations elsewhere are understood to have borne little fruit and the possibility of the government acquiring an active financial interest in oil production there appears to be limited to that one country.

Senate Has Oil Price Bill

Rep. Leon Gavin

With the Disney bill passed by the House, interest in oil price legislation now focuses on the Senate where the bill faces a real test. Its adoption by the House was foreshadowed when 218 members signed the discharge petition to take the measure from the Banking and Currency Committee and bring it directly to the floor.

Senator Thomas, Okla., has had a similar bill pending in the Senate for some months. Like the Disney bill in its original form, the Thomas measure would put crude prices on a parity with other commodities. But to overcome objections from certain groups and ease its way to passage, the Disney provisions were rewritten on the floor. Instead of requiring that the price be raised to parity, the bill as finally enacted made it mandatory that OPA fix prices not lower than 80 percent and not higher than 100 percent of parity. Also, the provision to transfer the price authority on crude from OPA to PAW was stricken out. Some members did not like giving Mr. Ickes more power.

Based on current crude prices—a national average of $1.18 a barrel, or 60 percent of parity—the increase as finally provided in the Disney bill would range from 35 to 74 cents.

Oil men are giving a big share of credit for the fact that the crude price question was brought to the floor of the House to Representative Leon Gavin, of Pennsylvania. Gavin "sparked" the drive to get signers for the discharge petition and personally led many recruits right up to the Speaker's desk and saw that they attached their signatures.

How Civilians Will Save

Gov. John J. Dempsey

Gov. John J. Dempsey, N. Mexico, believes Judge Vinson's rejection of a crude price increase will save the American people more than the $500,000,000 the Economic Stabilizer figured would have to be passed on to the consumer. He says if the people don't have gasoline they will have to walk—but he has not any figures on the additional cost of shoe leather.

The Governor favors a 50-cent increase—no subsidy, which he says is impractical because you would have people drilling for dry holes. The only place to get crude oil today at present prices is to take it away from civilians, Dempsey says.

Post War Tanker Use

Despite the fears expressed by some oil men that there may be a post war superfluity of tanker tonnage War Shipping Administration officials believe that there will be plenty of use for all the oil tankers to be released by the military and all additional new construction scheduled. They look for far greater imports of oil than pre-war.

Officials are thinking in terms of a dwindling domestic production that will make it necessary to look to South America, the Middle East and possibly elsewhere for supplies. The post-war utilization of tankers, they believe, will be due to the supply situation rather than competition with pipe lines to the East from the Texas fields.

Release of the tankers taken over by the Army and Navy will not be sufficient to handle the oil movement, and the demand for capacity will be so great that further construction will be necessary, officials believe.

In spite of pipe line construction, they say the Northeast will continue to be served by tankers, envisioning a possibility that the "Big Inch" may be diverted to carrying natural gas.

ELK HILLS OIL AND THE WAR EMERGENCY

By F. S. Bryant

Vice President, Standard Oil Company of California

For the past six months we have been working in Washington with the Navy Department, in an effort to reach a satisfactory settlement of the Elk Hills problem. There have been many discouragements and frequent doubts regarding the outcome, caused by the injection from various quarters of obscure arguments and misleading statements.

Now, however, the issue has at last been joined. The simple question is this—how can the Navy Department best accomplish its two-fold responsibility of protecting the present crude reserves in the Elk Hills Field of California—Naval Petroleum Reserve No. 1—and of providing at the same time for current production from that field of a type of crude oil which the Navy has stated is vitally essential to prosecution of the war?

Our company is concerned over the Elk Hills case for several reasons. Standard of California was the original discoverer of the Elk Hills field and owned lands there before the Naval Petroleum Reserve was established. That record refutes the critics who try to make it appear as if Standard worked itself slyly into the reserve and is now attempting to take something which does not belong to it. Despite the falsity of intimations to that effect, they still persist.

We fear, not only for ourselves but for the entire petroleum industry, that Elk Hills may be used as a starting point in some new offensive against private property; that perhaps the idea of confiscation will spread to dangerous proportions.

In conformity to a long existing understanding with the Navy Department, the bulk of Standard's lands in the Elk Hills field has not been developed or produced for more than twenty years. Today, with the extreme demand for crude to meet war requirements, it is essential that the field contribute in part at least to California's swollen quota.

F. S. Bryant

The Secretary of the Navy and Standard of California have finally evolved a well considered plan of unit operation for Elk Hills, by means of which Navy may successfully and assuredly conserve its present reserves, permit the withdrawal of a modest fraction of the field's acknowledged reserves and insure retention of the bulk of Standard's remaining reserves as added protection for Navy's own share.

The proposed unit plan guarantees Navy the conservation in the ground of its own share of the field's reserves, assures badly needed production of Standard's oil during the present emergency, places the great majority of Standard's remaining reserves in the field under strict Navy control and ultimately assures a maximum of equality between the parties. Also, if Navy so elects, Navy owned oil may be produced at absolute field cost.

The alternative advanced in some congressional circles—condemnation—would accomplish nothing that is not available under the present contract approach and would have definite disadvantages.

Increasing Navy's reserves is not contemplated under existing law. The law seeks merely to protect those reserves. But in the guise of protection, condemnation would result in greatly augmenting the reserves. Where is this to stop? Has a new philosophy been crystalized which would justify this action as an expression of the national will and if so, what would it ultimately encompass? Would this philosophy in time be extended to other oil fields throughout the nation?

Condemnation would not solve the question. In addition to its manifest unfairness, it would have a questionable legal basis. Also, the Attorney General has stated that without additional legislation, condemnation would close the door to continued production of vitally needed oil.

It would be tragic if lack of understanding of the true issues in this case resulted not only in an unnecessary invasion of private rights, but also in the flouting of the Navy's considered plan for increasing the effectiveness of America's war effort.

QUESTION OF ELK HILLS PUT UP TO CONGRESS

WASHINGTON

Attorney General Francis Biddle has passed on to Congress the decision as to how Navy is to handle the Elk Hills reserve—whether to acquire California-Standard's holdings by condemnation or contract with the company to operate the reserve. He declined to approve a proposed new contract between Navy and Standard and told Secretary of Navy Knox that it "should not be executed" without more specific approval by Congress than is found under existing statutes.

Biddle did say, however, that "the contract represents a carefully considered unit plan of operation, which now furnishes a concrete basis for Congressional consideration."

Terms of the new contract were worked out during the 90-day period provided by the rescission agreement that ended December 7 and was approved by Attorney General Biddle. An extension of the operating agreement for an additional 90 days has been okayed by Biddle during which Congress is expected to study the problem and express its views.

The House Naval Affairs Committee, which has been quietly working behind closed doors, now plans to hold open hearings beginning early in January. No vote has been taken but the attitude of the committee at the moment appears to favor government ownership of the whole Elk Hills reserve by acquisition of private holdings, probably through condemnation.

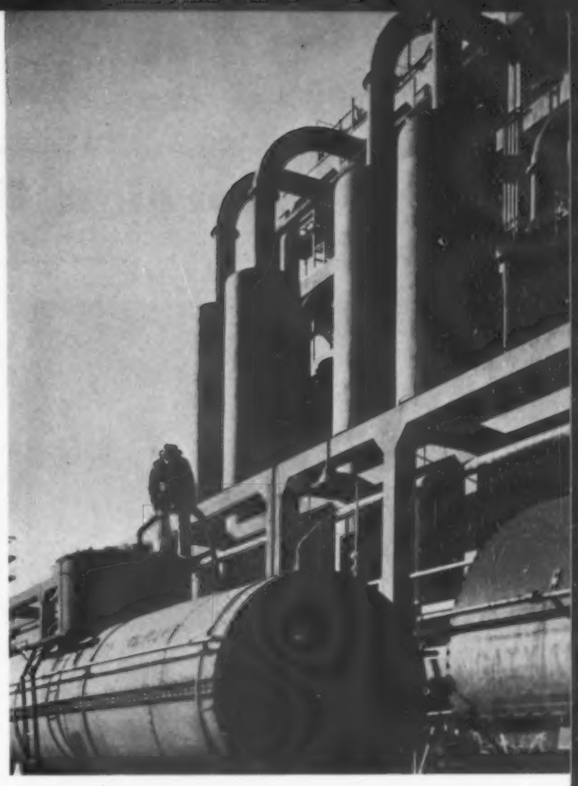
The question arises, however, whether the 15,000 b/d now being produced can be spared from war requirements. Navy can't operate the reserve itself, and now if ever oil is needed. So it looks as though some sort of deal for oil company operation would have to be made unless the country is to be deprived of the use of an invaluable petroleum supply located in an area where increased production is of the greatest importance and where private owners are being urged to extend their drilling and to bring to the surface every possible barrel that can be withdrawn without injury to their fields. In this connection it is pointed out that the naval reserves were established to provide oil reserves for an emergency and that now the emergency confronts the nation in full force and is acute on the Pacific Coast.

KOBUTA WILL PRODUCE 117,500 TONS OF BUTADIENE AND STYRENE

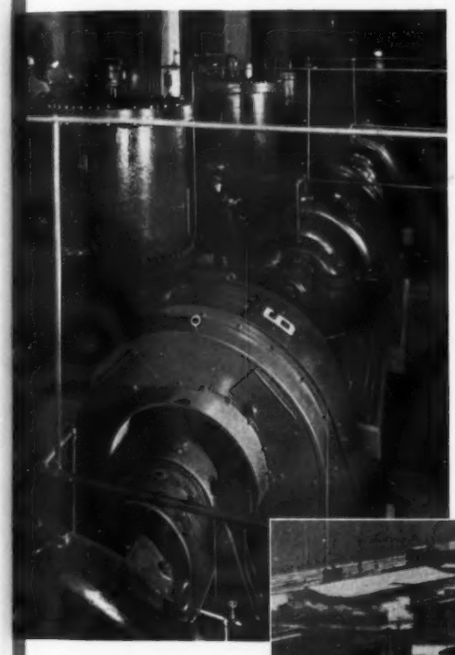
FORMAL opening on December 17th of the Kobuta plant at Pittsburgh, Pa., marks a noteworthy addition to the nation's facilities for producing butadiene and styrene, raw materials for the manufacture of synthetic rubber. The plant is one of the largest yet constructed to use alcohol as a main source material. Its rated capacity is 37,500 short tons of styrene and 80,000 tons of butadiene per year but it is expected that this will be exceeded in actual operation.

The plant occupies a tract of 200 acres of former farmland on the Ohio River and is located well above the high water mark. It was built by the Engineering and Construction division of the Koppers Company for the Defense Plants Corporation and is operated by the Koppers United Company, Butadiene Division, under contract with Rubber Reserve Company. Butadiene produced at this plant will be manufactured by the catalytic conversion of ethyl alcohol. The styrene will be obtained by cracking ethylbenzene. The ethylene is derived from the dehydration of alcohol and the benzene is a by-product of coking plants. In the original plans for the project it was proposed to utilize benzene as the principal raw material for butadiene, using a process developed by Koppers before the war. This was changed because of the heavy demand for benzene in the blending of high-octane gasoline and the ethyl alcohol process was substituted.

Between 80,000,000 and 100,000,000 gallons of alcohol will be required yearly in the operation of the plant and this can be made from refinery gases, molasses or grain. The consumption of benzene is now at the rate of 1,000,000 gallons monthly for styrene only. Coal, delivered to the plant by barge, will be used at the rate of 500,000 tons per year. The eight story power plant generates steam at the rate of more than 1,000,000 pounds per hour and this steam drives turbine generators producing 35,000 kilowatts of electricity and then goes to operate stills, superheaters and compressors throughout the plant. The pumping station supplying the plant with water delivers 120,000 gallons per minute—more than is used by the entire city of Pittsburgh. This is independent of the system supplying drinking water to the plant and to the 300 homes of workmen nearby. To insure against river contamination new types of equipment were designed and installed under the direction of the Pennsylvania State Department of Health.



Finished Styrene Flows Into Tank Cars for Shipment to Various Copolymer Plants.



Above: Water Pumps Supply Kobuta With 120,000 Gallons of River Water Per Minute.

Partial View of Kobuta's Butadiene and Styrene Plant.

Below: Podbielniak Apparatus Saves Hours of Laboratory Time.

Foreign Oil Legion

Left to Right: Capt. Stedman; Capt. Sigona and Willard F. Jones, general manager, Marine Department, Gulf Oil Corp.

CAPTAIN Peter J. Sigona, master of a Gulf Oil tanker, was awarded the Merchant Marine Distinguished Service Medal by Captain Giles Stedman, superintendent of the U. S. Merchant Marine Academy. By clever maneuvering and fast thinking, Sigona was able to elude five torpedoes which had been fired at his 75,000 barrel cargo of Navy fuel. The sixth torpedo just glanced off the bow of his vessel.

T. L. STROMBERGER, a member of Union Oil Company's advertising and publicity staff, has been appointed advertising sales representative for the company. He will handle product and service advertising, direct the publication of Union's "Dealer News" and many other sales promotional activities, reporting to Arthur C. Stewart, vice president in charge of sales.

ANTICIPATING post-war developments in overseas operations, The Texas Company has consolidated its Export Sales Department and Producing Department—Foreign into a unit to be known as Foreign Operations. Under the new arrangement an executive division has been created, with W. F. Moore and W. H. Borie as assistants to the vice president in charge of administration and sales respectively. Harris T. Dodge becomes general manager of Foreign Sales. W. I. Moody has been appointed assistant to the management in the new executive division. A. J. Singleton and O. B. Small have been named assistant general managers of the Sales Department.

WALLACE E. PRATT, vice president of Standard Oil Co. (N. J.), and John R. Suman, vice president of Humble Oil & Refining Company in charge of production, have been elected directors of the American Institute of Mining and Metallurgical Engineers to serve during 1944. Chester A. Fulton, president of Southern Phosphate Corporation, is the new president of AIMME.

AT a meeting of the Board of Directors, Mr. John M. Crawford resigned as president of the Parkersburg Rig and Reel Company and Mr. A. Sidney Knowles has been elected as his successor. While relinquishing the presidency, Mr. Crawford is retaining his position as chairman of the Board of Directors.

Mr. Knowles has been active in the operation of the Parkersburg Rig & Reel Company since becoming a member of the Board of Directors in 1936. He served in this capacity until October, 1942, at which time he was elected executive vice president.

ACCORDING to the Colombian Oil-News Digest, a company known as United Associates S.A. has been organized in Venezuela by Herbert Hoover, Jr., A. A. Curtice and Glenn Ruby, to act as technical and economic consultants to South American governments in oil matters. Members of the company served as technical advisors to Venezuela in the drafting of its recently adopted oil law and have done exploratory work for the Brazilian, Argentine and Chilean governments.

MAX W. BALL, former president of Abasand Oils Limited, engaged in the development of the northern Alberta tar sands, which was taken over by the Dominion government, is moving his headquarters from Edmonton, Alberta, to First National Bank Building, Denver, where he has maintained an office as consulting petroleum engineer since 1928. He will continue to act as consulting engineer for the Abasand Company.

FIVE executives from the petroleum industry have been elected to membership in the Controllers Institute of America—Ernest C. Breeding, assistant comptroller of The Texas Company, and E. H. Mueller, treasurer of the Shell Pipe Line Corp., both of Houston, Texas. Ralph A. Cuthbertson, general auditor of the Cities Service Oil Company, New York; and H. O. King and F. S. Slick, comptroller and assistant Comptroller, respectively, of the Ohio Oil Company, Findlay, Ohio. The Institute is a technical and professional organization of controllers devoted to improvement of controllership procedure.

DAVID MILLS HAMMETT, vice president of Axelson Manufacturing Company, died November 30 at his home in Whittier, Calif. Mr. Hammett was well-known in oil circles in 1922 when he joined the Axelson Manufacturing Company as a salesman. His rise was rapid, and soon he was appointed district sales manager. In 1927 he was made Mid-Continent sales manager, and in 1933 was elected vice president of the company.

T. L. Stromberger

A. Sidney Knowles

David Mills Hammett

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RICHFIELD'S WAR PRODUCTION PROGRAM NEARS COMPLETION

WORK is now under way on the final unit of Richfield Oil Company's $14,500,000 war production plant at Watson, California. This includes a thermafor catalytic cracking installation under construction by The Lummus Company for the production of aviation gasoline, together with additional alkylation facilities and new fractionation equipment. Upon its completion, early in 1944, Richfield will employ over a thousand men in its refinery operations and will be producing every twenty-four hours enough 100-octane gasoline to fuel a thousand Flying Fortresses on a bombing expedition over Europe.

Inception of the company's plans for refinery expansion goes back to 1938 when an entirely new plant was completed at a cost of $5,000,000. This plant embraced the latest methods of the time in refining, cracking, polymerization and gas-handling and separation. Since that time, construction work has been in almost continuous progress at the refinery site. Including this original installation, Richfield has now spent, or committed itself to spend, $25,000,000 in a long-time program to participate to the fullest extent in the war effort. At the present time about 20 percent of the company's crude is being converted into aviation gasoline.

After the completion of the combination refining and cracking units in 1938, an alkylation unit was authorized, designed and completed by June, 1939, and the company was turning out 100-octane gasoline many months before Pearl Harbor. At that time units of this type were a curiosity in the petroleum industry. They embraced a process which had been regarded by petroleum chemists as impossible, that is, the combination under the influence of catalysts of a gaseous iso-parafin hydrocarbon with a gaseous olefin hydrocarbon to form a higher iso-parafin. This process which was still more or less of a laboratory curiosity was to become the basis of the world's production of 100-octane gasoline, producing as it does hydrocarbons of extremely high octane value which can be blended with other more readily available petroleum products to form 100-octane aviation fuel. The plant embraced engineering features never commercially used before and paved the way to the realization of higher yields of higher quality blending agent, than had ever been produced before. In September 1942, Richfield completed its plant for the production of cumene, another hydrocarbon which had been a laboratory curiosity only a few months before. This plant is one of only a handful in the United States. Immediately upon the outbreak of war, the company started the construction of additional facilities, practically doubling its existing alkylation unit, and the installation of equipment for producing superior base stocks for aviation gasoline. This project included a super-fractionating unit to which all straight-run gasoline and casing-head gasoline is fed. In this unit desirable fractions of high-octane blending values are separated from low-octane fractions, worthless in the production of aviation gasoline. This materially increased the quantity of 100-octane gasoline which could be produced from a given barrel of crude and was one of the first large-scale installations of this type. Another newly discovered process installed at that time was an isomerization unit which, with the aid of a catalyst, converts normal butane, which cannot be extensively used in aviation gasoline, into iso-butane, one of the most important raw materials used in the alkylation process above referred to.

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NEW YORK NOMADS have followed the custom since the establishment of their chapter of holding an annual Christmas party in December of each year. This season the party was held at Sherry's on December 4th and marked a new high record in attendance. [Snapshots of a few tables indicate that the occasion was an enjoyable one.]

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Petroleum World Annual Review

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Practical Oil Geology

By Dorsey Hager

• As in the previous editions of this book the author has held to the purpose of assisting oil men to a better understanding of geology in its relations to petroleum. It contains a list of recent books on oil and general geology and an index. 466 pp. *Fifth Edition*, pub. 1938.....$4.00

Fundamentals of the Petroleum Industry

By Dorsey Hager

• An introduction to the petroleum industry in all its phases, for all who want a check on effective methods of management and engineering in the production and marketing of oil. 133 Ill. 445 pp. Pub. 1939 .....$3.50

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WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry—Edited by Dr. O. W. Willcox.

GEOLOGY

Geological Significance of Oil-field Waters and their Relationship to Structure and Production—Walter R. Berger, before American Institute Mining Metallurgical Engineers, Austin (Texas), November, 1943.

It is reported that a study of the chemical analysis of oil field waters has shown that in some geologic basins there is apparently a relation between the salt concentration of the water and the configuration of the basin. The total solids increase basinward and their amount is less on structural highs than in adjacent synclines. The constituents vary sufficiently to allow inferences regarding structural areas and possibly production of oil. Additional study might prove the relations that are to be anticipated in many basins, thereby giving the oil industry a new tool in oil exploration.

GEOPHYSICS

Natural Potentials in Sedimentary Rocks—Parke A. Dickey, in PETROLEUM TECHNOLOGY, September, 1943, Technical Publication No. 1625, 10 pages.

Potential differences between strata of shale and sandstone have been recognized for about 15 years, and they form the basis of the electrical logging of oil wells. Hitherto these potentials have been ascribed solely to electrochemical reactions caused by the disturbing effects of the water in the drill hole through which they are generally measured. Observations by the author in wells empty of water and in a mine shaft suggest that potential differences between sandstones and shales are natural and specific properties of the rocks, although they are modified in measurement by the disturbing effects of the water in the drill hole. The cause of these potentials probably is to be sought in the relative polar adsorptive capacities of quartz and clay particles.

OPERATION

Salt Water Disposal Program in the East Texas Field—L. H. Dial, before AMERICAN INSTITUTE MINING METALLURGICAL ENGINEERS, Austin (Texas), November, 1943.

There are now 61 salt-water disposal wells in the East Texas field, 22 of which are operated by the author's company (East Texas Salt Water Disposal Co.). The method of sinking and completing these wells is described.

Corrosion is an ever-present problem. Pipe lines, pumps, and indeed all the equipment which comes in contact with salt water must be designed to withstand severe corrosion. Asbestos cement pipe has been found to be particularly suitable in the handling of salt water. In addition to being corrosion resistant, it also offers immunity to tuberculation and electrolysis, two forces which also reduce the useful life of pipe.

Another kind of pipe which has been used with success in a limited field of application is a wood-fiber coal-tar product. It is corrosion resistant also, but it cannot be used except on gravity lines and then only where the pressure does not exceed 15 lb. per sq. in.

Where high pressures are required, cement-lined steel pipe has been found to be most satisfactory. The cement lining protects the steel from the salt water on the inside, but the outside is subject to soil corrosion. Laid in ground impregnated with salt water, the steel cement-lined pipe has a very limited life as compared to either the asbestos cement pipe or the wood-fibre coal-tar pipe.

DRILLING

Drilling Efficiency Under Wartime Conditions—Arch H. Rowan, before AMERICAN PETROLEUM INSTITUTE, 24th Annual Meeting, Chicago, November, 1943.

Statistics indicate that 17,352 oil wells will be drilled in 1943. This represents a decrease of 46 per cent over 1941 completions and 4 per cent over 1942. The decrease in completions this year as compared

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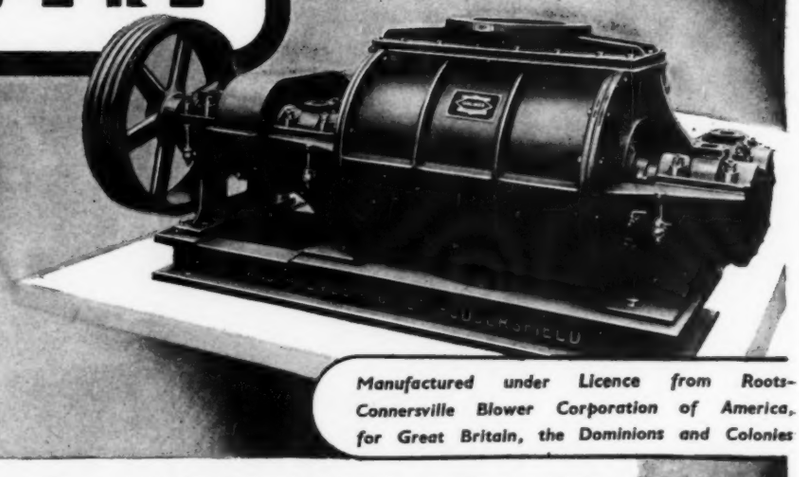

These machines deliver a positive, reliable and oil-free supply of air, economically and efficiently. Absence of internal contact ensures long life, low maintenance costs and continuous operation over long periods.

It is also extensively used for Gas Exhausting or Boosting and over 1,400 machines have been supplied for these purposes.

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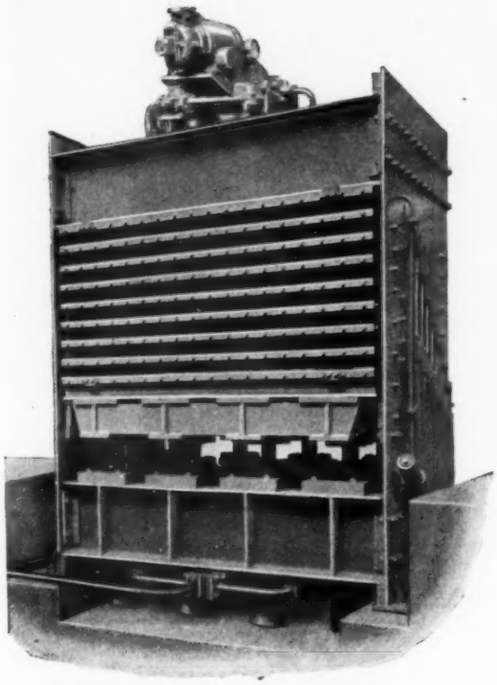

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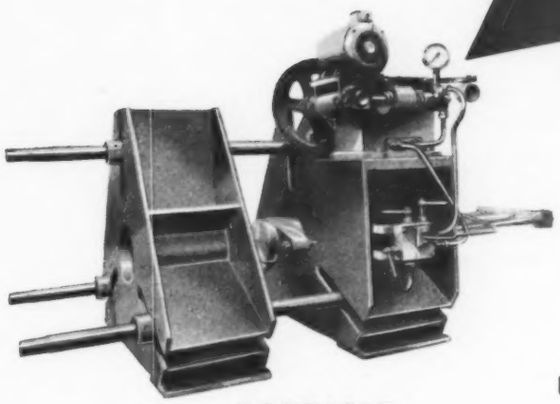

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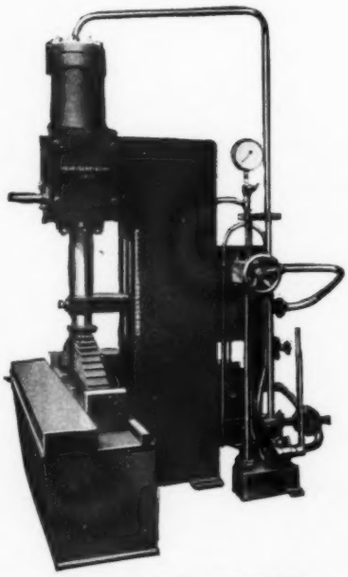

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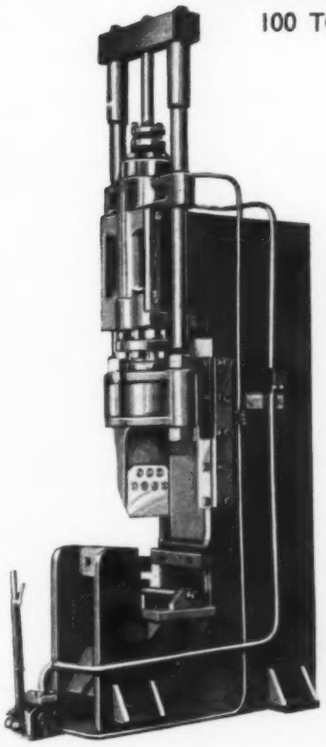

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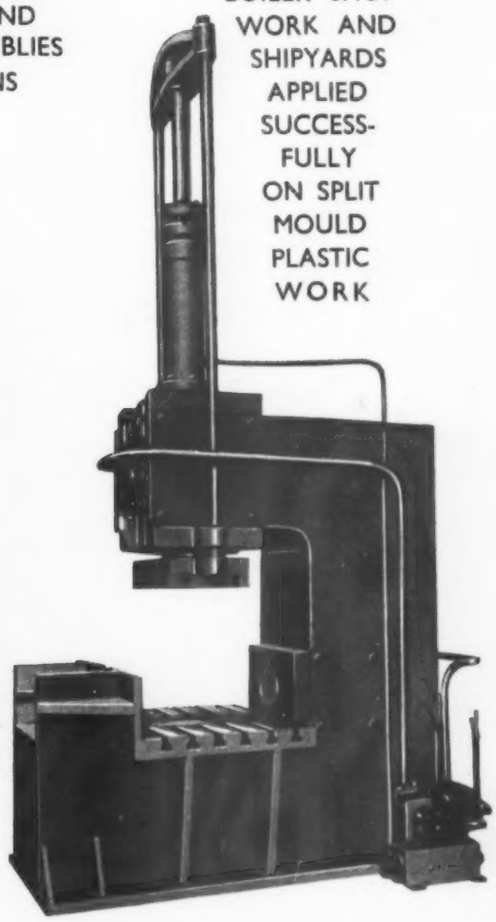

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to 1941 and 1942 has marked significance in view of the accelerated drilling program now in progress and clearly indicates a present lack of efficiency in drilling operations. The slow down in well completions can be attributed to a combination of factors:

1. A great many of the wells drilling at this time are wildcat wells which require a greater length of time than wells drilled in proven territory.
2. The depth of drilling today is generally greater than the depth of drilling in 1941 and 1942.
3. The lack of repair parts, the inferior quality of of material used in making bits, the shortage of skilled labor, and the use of inexperienced or inefficient labor in the drilling of wells—all of these conditions together with governmental restrictions and regulations, are largely responsible for the decrease in well completions, notwithstanding the fact that we are now engaged in an accelerated drilling campaign.

Problem 3 is analyzed in some detail. In almost every instance where a part has to be replaced, the supply store does not have the part in stock; it has to be ordered from the factory. This part may be a very minor one and cost only a few dollars; nevertheless, the drilling rig is shut down for a period of from two to five days waiting on this part to arrive from the factory. During this period of time, not only the drilling equipment remains idle but also the men who are maintained on the payroll remain idle, doing practically nothing. It is apparent that priorities have not been issued high enough to permit the supply companies to maintain adequate field stocks of replacement parts. On a rig which recently completed a well in East Texas, mechanical failures developed, the replacement parts were not available, and shutdown time of 28 days out of 100 days overall time resulted.

A particularly sore point is that the driller now has to use rock bits of inferior steel. Only 3 per cent of the steel used in the bit is actually lost, and the need for more drilling would be better served by putting good steel at the disposal of the drillers.

In summing up, it can be stated with some degree of accuracy that the lack of replacement parts has resulted in a 10 per cent decrease in efficiency in drilling operations; the shortage of skilled labor and the use of inexperienced drilling crews has resulted in a 20 per cent decerase in drilling efficiency. While no information is now available relating to the inefficiency caused by the use of inferior bits, it is the consensus among drilling contractors that this inferior quality of steel has resulted in a 10 per cent decrease in drilling efficiency.

PIPE LINES

Suggested Formula for Calculating Capacity of Products Pipe Lines—T. R. Aude, before AMERICAN PETROLEUM INSTITUTE, 24th Annual Meeting, Chicago, November, 1943.

Internal corrosion of gasoline and products pipe lines first brings itself to notice by a reduction in the capacity. This reduction in capacity is principally caused by roughening of the pipe wall due to the formation of corrosion products. It is doubted that there is any appreciable decrease in the mean diameter of the pipe caused by the formation of corrosion products on the walls. This effect of internal corrosion is so important that the capacities of some lines handling gasoline have decreased 10 to 15 percent within a few years. Most operators of products pipe lines now resort to scraping, the use of inhibitors, or both in an effort to counteract the effects of internal corrosion and maintain their lines at or near the original capacity. Another result of internal corrosion, perforation of the pipe wall causing leaks, may be equally important, but it does not occur so quickly.

The importance of the capacity losses which may result from internal corrosion, and their relation to the economical operation of products lines, makes it desirable to have some convenient means for expressing the condition or roughness of the line. Such a factor, to be most useful and universally applicable, should depend only on the condition of the line in question, and should not vary with any of the other factors entering into its operation.

The Hazen-William formula originally was developed by engineers for use when water was the flowing liquid. When so used, the factor C in this formula was a pure line-condition or roughness factor. This is not always a clear expression of the condition of the line, inasmuch as any adjustment for the viscosity of the product must also be included in the C factor.

The Fanning formula, as modified by Heltzel for crude-oil pipe lines, gives accurate results when

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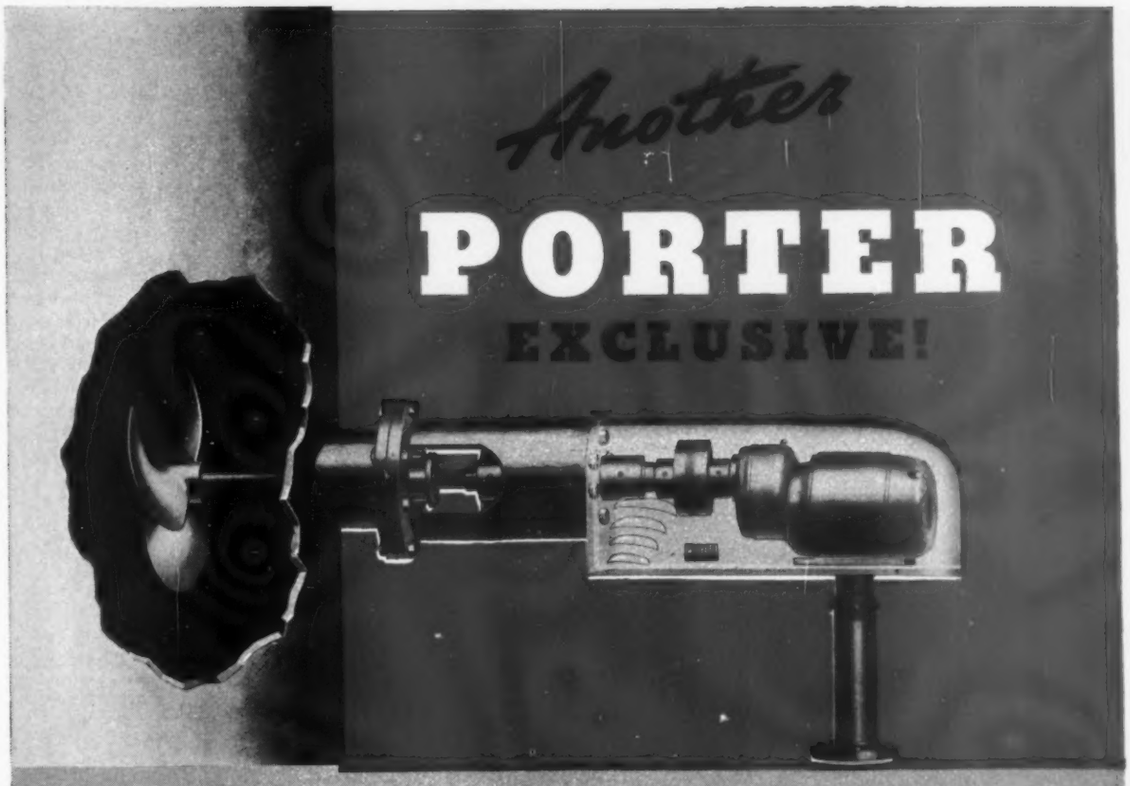

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applied to products lines of new 6-in. and 8-in. pipe. It is suggested that the introduction of a line-condition factor in Heltzel's formula would make it applicable to products lines of any degree of roughness. In like manner the introduction of an expression for viscosity in the Hazen-Williams formula would make C a pure line-condition factor, varying only with roughness.

The author offers some new formulas which include a factor K that is referred to as a "specific line-condition factor", which is the ratio of the capacity of any pipe to the capacity of a smooth pipe.

NATURAL GAS

Reforming Refinery Still Gases for Market Consumption—R. L. Bevan, in OIL AND GAS JOURNAL, Vol. 42 (1943), No. 15, pp. 52, 55-6, 59.

In view of expanding requirements of war industry for fuel gas and a relative shortage in the supply of natural gas, the Union Gas Company of Canada purchased refinery still gas at the rate of 2.6 to 3 million cubic feet per day in winter and 4 to 6 million cubic feet in summer. It was necessary to process this still gas so that it would be fully interchangeable with natural gas when burned in natural-gas appliances. It was especially required to reduce the heat value from about 1600 B. t. u. to 1000 B. t. u.

The process employed is known as the Dayton-Faber system. The first step is to deprive the still gas of its rather large content of H_2S, which is accomplished by passing it under 50-60 lbs. pressure through an 8-10 per cent milk of lime slurry. Approximately one-fourth of the purified gas is then sent to the gas-reforming equipment where it is burned by the Faber process in such a way that its heat value is reduced to about 400 B. t. u. After cooling and washing to remove combustion acids the reformed gas is scrubbed with oil to remove naphthalene that has been formed in the combustion. Tar and other condensable impurities are removed by a Cottrell electrical precipitator. The reformed gas is then mixed with the rest of the still gases to produce a mixture of 1000 B. t. u., and after a final scrubbing to remove the lost traces of naphthalene is flowed into the distribution system. The total overall thermal conversion efficiency is 96.15 per cent.

ASPHALT & TAR

A Method for Evaluating Performance in Service of Slow-curing Asphalts—Joseph Zapata, in ASTM BULLETIN, October, 1943, No. 124, pp. 31-39.

Field and laboratory evidence indicate that a heat test of the type described in A.S.T.M. Method D 243-28 T can be used for the evaluation of performance in service of slow-curing asphalts.

The test can be used for control purposes by either specifying the time required to reduce the consistency of the asphalt from original to a consistency of either 100 or 150 penetration, or by specifying the consistency of the residue obtained after heating the asphalt for a given period of time.

COMING YEAR CALLS FOR SUPREME WAR EFFORT

(*Continued from page 41*)

mated that this year its use will be more than double that amount. An 855-plane attack on Vegesack and Bremen burned 25,000 gallons of lubricating oil and a million gallons of gasoline. If those 855 planes were "A" card holders, they could drive for eleven years on that amount.

A single mechanized division requires 18,000 gallons of gasoline every hour that it is on the move. Every Flying Fortress must set out with at least two tons of gasoline for its mission of destruction.

The story of oil for 1943 is one of astounding achievement by the petroleum industry in going all-out for victory without counting the cost. It is also a story of the awakening of the American people to the importance of petroleum products in their way of living, and to their continued existence as a free nation. It is a story, too, of people doing without and sacrificing many of the conveniences and comforts that oil has made possible so that their soldiers and sailors and flyers may not want for the vital ingredient of victory. And finally it is a story that, swelling and surging in volume, will become a full-throated paean of victory, God willing, in 1944.

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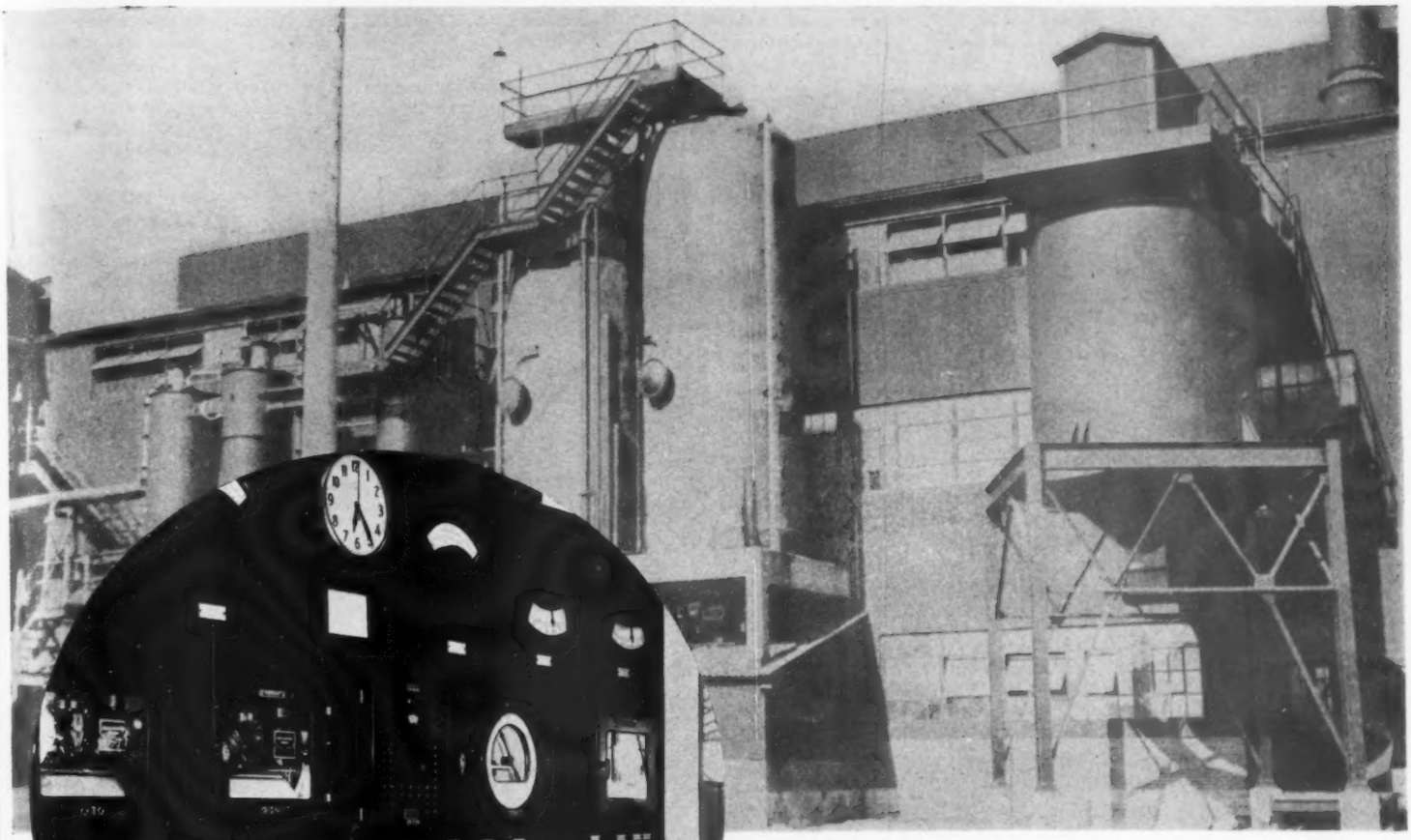

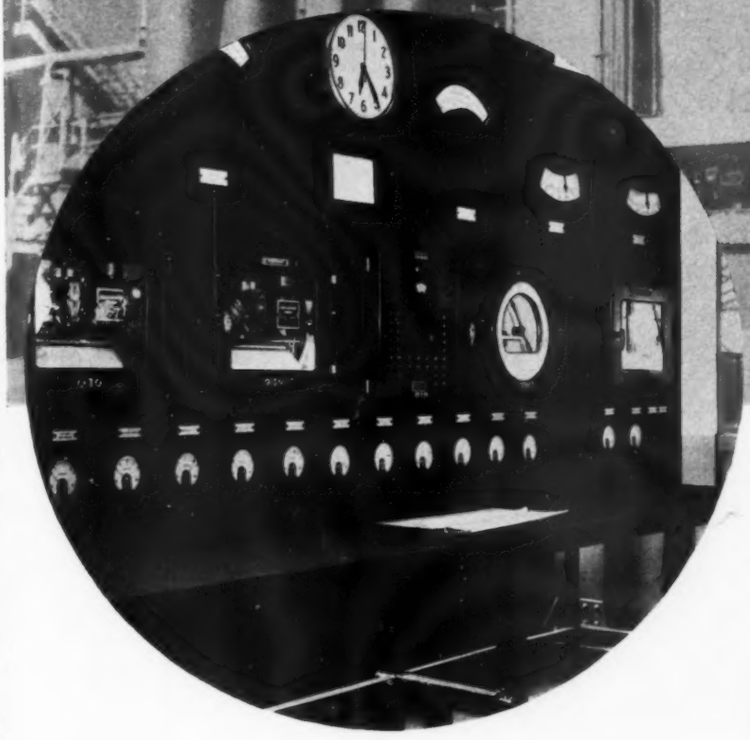

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PHYSICS

Permeability As Related to Productivity Index—Norris Johnston and John E. Sherborne, before AMERICAN PETROLEUM INSTITUTE, 24th Annual Meeting, Chicago, November, 1943.

It matters little whether the petroleum engineer is concerned with problems relating to well spacing, increasing potential production, increasing ultimate recovery or, in fact, almost any problem involving production from a petroleum reservoir; finally he is confronted by an inadequate amount of information pertaining to the mechanics of flow in the reservoir. This arises not from the scarcity of information which has been published in the field, for many hydrologists and physicists and, in recent years, many petroleum engineers have investigated fluid flow in porous media. Instead, the difficulty arises from the fact that by far the greater part of the work has been confined to homogeneous flow, whereas only a few investigators have published material relative to heterogeneous flow in porous media.

Experimental work with heterogeneous systems is difficult to perform, and to date it has not been found practicable to institute routine permeability measurements involving heterogeneous flow. For these reasons it has been found necessary to attempt to relate information obtained, for the most part, from homogeneous flow studies to the actual behavior of wells and reservoirs.

The authors have, therefore, tabulated pertinent data on 147 California oil wells on which thorough core-analysis and productivity-index data were available. One conclusion reached is that reservoir viscosity of oil is equal to that of sand permeability itself in determining flow. The modified specific productivity index function is studied graphically for these wells. The conclusion is also reached that, although the well behavior for high-permeability sands approximates the theoretical, there is an increasing deviation between actual performance and theoretical possibility with decreasing permeability. The spread of individual well performance from the average California SPI-k curve may be accounted for by deviations between air and water permeabilities, variable spread of permeability values, by varying stages of reservoir depletion, and by varying efficacy of well completion. It is expected that these variables will be studied further as more data become available.

REFINING

How to Handle Anhydrous Hydrafluoric Acid Safely—Charles M. Fehr, before WESTERN PETROLEUM REFINERS' ASSOCIATION, Tulsa, July, 1943.

The use of anhydrous hydrofluoric acid (AHF) has recently been introduced into petroleum technology, chiefly as a catalyst for the manufacture of itooctanes from isobutene and butylene. This acid is now being manufactured in thousands of tons in seven large factories, and is shipped to the refineries in tank cars. This acid is classed among dangerous chemicals which require great care in handling and using. Heretofore hydrofluoric acid has been shipped and used in water solution. The anhydrous acid is quite different; in this form it has the following properties: Freezing point, approximately—117.4° F. This unusually low value assures that it may be stored and used in process at very low temperatures without the problem of solidification. Boiling point, approximately 66.9° F. at atmospheric pressure. This is ideal, assuring ease of handling either as a liquid or a gas. The vapor pressure, which is about 17 lbs. per sq. in. gauge at 100° F. assures storage in medium pressure vessels and its retention as a liquid at elevated temperatures without objectionable pressures. The low viscosity and surface tension causes the acid to flow easily in comparatively small pipes. Less equipment is required and less time is consumed in transferring. The heat of reaction with water is approximately 11,500 cal. per formula weight. Less heat of reaction will be evolved than with other alkylation catalysts and temperature control should be simplified. Heat of vaporization is about 6,000 cal. per formula weight, assuring its removal from reaction products by application of a small quantity of heat.

The anhydrous acid has a low rate of corrosion on mild carbon steel, preferably a dead-melted or killed steel which is the logical material for tanks, pumps, valves and fittings. A protective coating forms on the surface of the steel, which may cause valves to stick unless they are turned at least twice a shift. Monel metal should be used in the control laboratory; copper tubing is excellent for feasible connections. Transferring AHF is a major problem, and may be done by the pressure of dry air or gas, or by pumping, preferably the former.

Although safety in the use of this chemical is largely the function of materials and design, the operating personnel should be well trained in its use; the fumes may cause serious burns and irritations, which may be counteracted by protective clothing and ointments. The author, who has had long experience in the large-scale manufacture of AHF, gives a very full outline of safety measures and first aid treatment.

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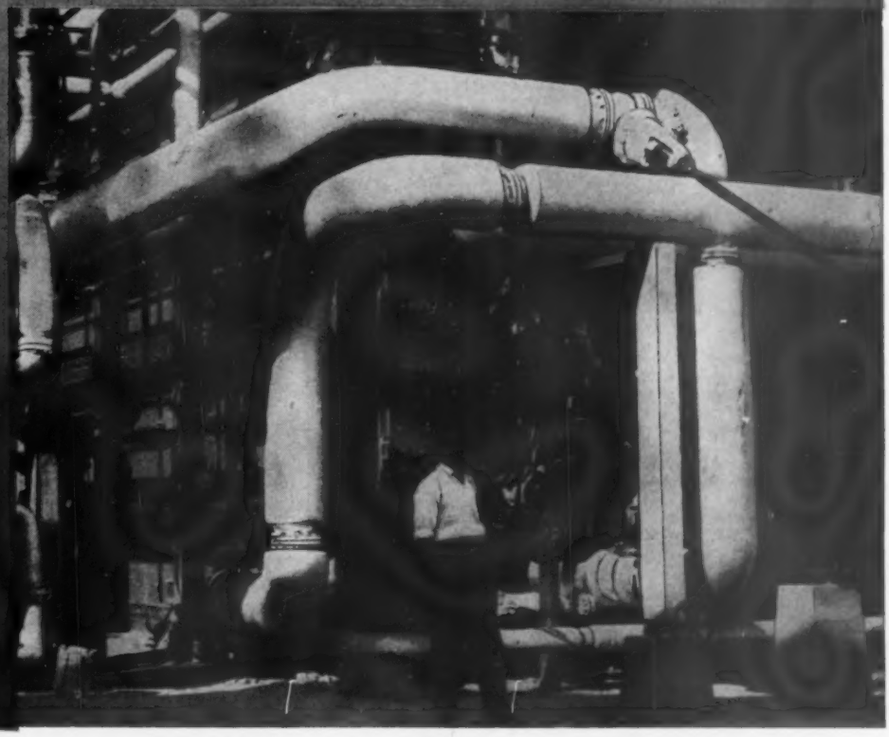

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Cracking Coils at War—They Can Take It— P. J. Harrington, M. S. Northup and C. O. Rhys, Sr., before AMERICAN PETROLEUM INSTITUTE, 24th Ann. Meeting, Chicago, November, 1943.

A method is proposed for calculating the safe working life of cracking-coil tubes as a function of the internal oil pressure, the tube material and dimensions, and the outside tube metal temperature. It is shown that:

$$T' = 11.4\left(\frac{F}{f}\right)^N$$

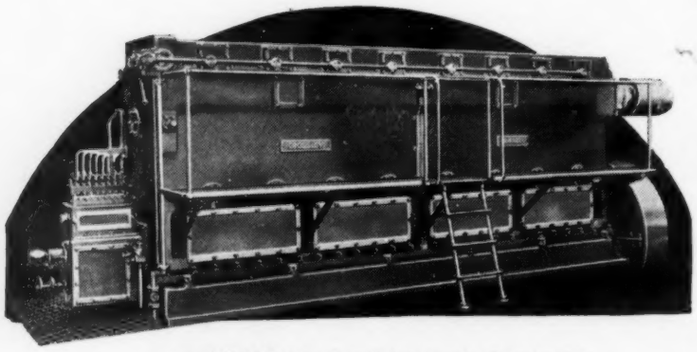
where T' is working life in years, F is the equivalent strength of the metal in pounds per square inch, f is the stress on the tube metal in pounds per square inch, and N is a constant depending on the tube material. Also:

$$f = \frac{RP}{1.2t},$$

where R is the outside radius of the tube in inches, P the pressure in the tube in pounds per square inch, and t the tube wall thickness in inches. The relation of F to outside metal temperature for common tube materials is also given. The effects of corrosion and scaling, varying service conditions, heat density, safety factor inherent in the method, experience of the Standard Oil Company (New Jersey) in application, and the relation of the method to the increased supply of war products are discussed. It is believed that aviation-gasoline-component production in existing thermal-cracking equipment could be increased considerably by widespread application of the method of tube-life calculation given if a one- to three-year safe tube life is felt to be justified by the need for this product.

Operations designed to compare predicted and actual cracking-coil tube life as a function of operating conditions are reported (see accompanying table).

Material	Tube Size (Inches)	Operating Pressure (PSI)	Operating Outside Tube Metal Temperature (Deg F)	Service Life to Date (Years)	Calculated Life (Years)
5-per-cent chrome-molybdenum	4½ x 3¼	750	1,200	3.3	4.5
5-per-cent chrome-molybdenum	4½ x 3¼	750	1,225	3.0	4.1
5-per-cent chrome-molybdenum	4½ x 3¼	550	1,195	2.3	4.5
18-8	4½ x 4	40	1,570	2.0	11.4+
18-8	4½ x 4	50	1,470	0.9	11.4+
18-8	4½ x 3.7	1,000	1,200	6.8	11.4+
		25	1,600	0.1	11.4+
				6.9	
Carbon steel	4½ x 3⅜	750	1,000-1,100	1.0	3.1
		50	1,480-1,580	0.1	1.9
				1.1	



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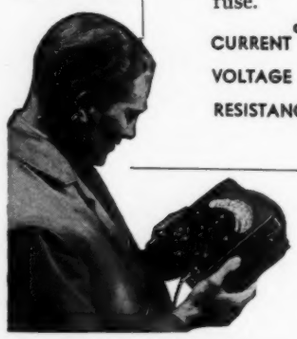

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ALLIED ENCIRCLEMENT THREATENS AXIS PETROLEUM SUPPLY

(*Continued from page* 28)

trolled Europe. The virtually complete devastation of the manufacturing cities along the Rhine, of Hamburg and more recently of Berlin, provides the pattern of aerial attacks that will extend over a much greater area during the coming months, paving the way for final land attack. In past assaults oil refineries, oil storage depots, transportation centers and manufacturing plants turning out essential war equipment have been frequent targets. It is obvious that whether destruction falls upon factories producing essential parts of guns, tanks, trucks or planes, upon power plants and transportation facilities, or upon refineries and oil storage, it works to the same end of weakening the volume of vitally needed production and the strength of enemy resistance. When the last of these has been crippled or destroyed, the power, if not the will to continue fighting, will have vanished and there will be left no alternative to unconditional surrender.

At the other end of the Axis, in the Pacific, the situation is somewhat different. Judging from the course followed thus far Japanese domination of that area will be overcome by combined naval and air attack. Bitter land fighting will accompany and complete these assaults as they move forward but the ground forces engaged probably will be much smaller than in the European conflict. Until the striking power that can be thrown against them becomes greater and more concentrated than it is at present, Japan's requirements of petroleum products are likely to be much less than those of Germany.

To satisfy these requirements, however, Japan will have to depend to a great extent upon supplies drawn from the East Indies. As the Allies gain control of bases nearer to this area their air forces will be able to make more frequent and more effective raids upon Japanese controlled oil installations. A number of long range bombing attacks have been made upon refineries and storage tanks in Celebes and Java and from the opposite direction against Burma. Even the small but hard hitting squadrons of the Flying Tigers in China have conducted a number of raids against oil objectives in the Japanese held coast cities. The decisive blow against Japan's petroleum resources can hardly be expected however until it becomes possible to launch attacks in sufficient strength to cut the transportation lines on which the Nipponese supply of oil and other essential products depends and to establish a virtual blockade of the home islands. This is a matter of bringing many more ships and planes into action in the Pacific area, a movement that appears now to be getting under way. Japan's position originally was in many respects more vulnerable than that of Germany, but it is now strongly buttressed by the extensive conquests made by the Japanese in the early period of the war.

STABILITE is very effective in freeing mud of entrained gas. Mud at left is badly gas-cut. Below—same mud after STABILITE treatment.

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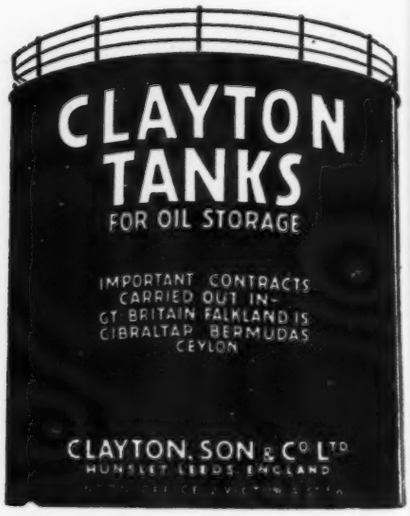

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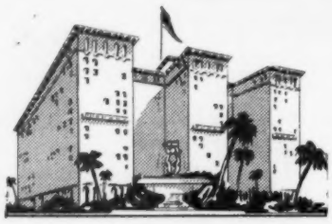

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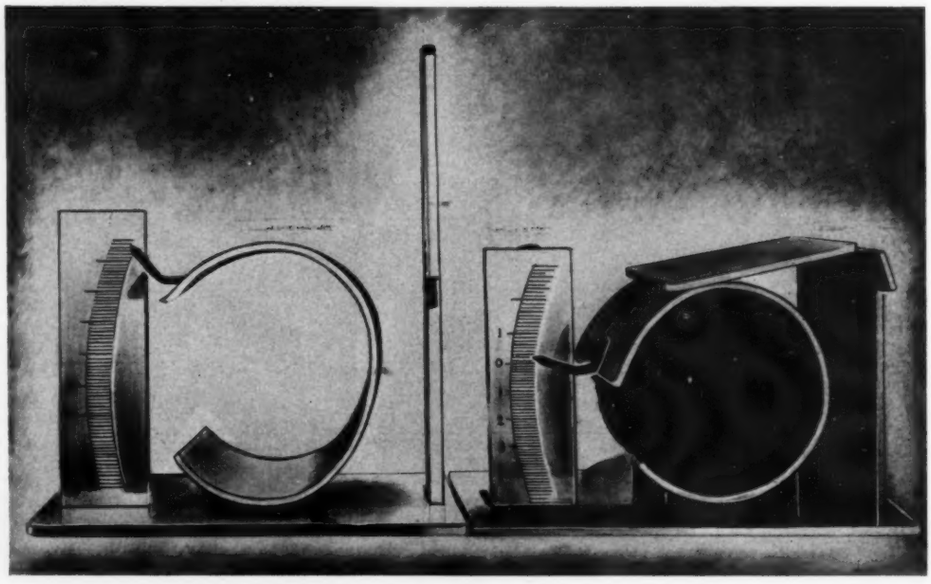
USES

New Testing Methods for Lubricating Greases—H. Weichelscheid, in OEL AND KOHL, Vol. 37 (1941), No. 13, pp. 236-240.

In this report the director of research on bearings for the German railway administration describes some interesting tests for revealing the properties displayed by greases in practical use. Emphasis is laid on the reproducibility of these tests.

The consistence test is carried out as follows: The grease to be tested is placed in a container F, the bottom of which functions as a perforated plate. The container F is placed upon the vessel A and is covered with the hood C; all joints are ground to air tightness. F and C are connected to a vacuum line with a two-way valve at P and a stopcock at D. After placing the grease in F the entire apparatus is evacuated of air with D open. Then D is closed and air is admitted into C. The vacuum (100 mm of mercury) in A tends to suck the grease through the perforated plate and the mercury in the manometer falls in proportion to the amount of grease that passes through, which again depends on the relative softness of the grease.



The time rate of the fall of the mercury is recorded by photographing the manometer at intervals and constructing a curve. Different temperatures may be used. Before the test is made the grease should be vigorously mixed. According to the author, the tests are "unconditionally reproducible."

Another test is designed to measure the tendency to separate oil on warming up. For this test use is made of an aluminum vessel 73 millimeters wide and 80 mm tall; it has a bottom containing 271 holes 2 millimeters in diameter; 350 grams of the grease are placed in this vessel, which in turn is hung in a sufficiently large glass vessel. The whole is then maintained at a temperature of 80° C. for 50 hours, whereupon the oil that has passed through the holes is collected and weighed. The amount of oil thus separated should not exceed 2 percent (7 grams). The test figures on four very different greases show excellent reproductibility.

The author describes a "gel test" for railway bearing greases, the necessity for which arises out of the following circumstances: When a grease box is opened after a run there may be seen a gummy cake; no oil adheres to the metal, so the bearing is dry. This is due to the fact that the solubility of the soap in the oil is not complete except at high operating temperatures, when a gel of oil and soap is formed; at lower temperatures a part of the soap again separates and the gel character disappears. For determining this gelling property the following test is used. A sample of the grease is packed into an 80 x 73 mm cylinder provided with a perforated screen bottom, vessel and grease are placed on a tripod and kept at 80° C. for 24 hours to separate a portion of the free oil. Thereafter the wad of grease is removed and enclosed between the halves of a split cylinder (see sketch) which are hinged together on one edge and loose on the other. After putting the wad of grease in position the upper half of the split cylinder is pressed down so as to lower the pointer on the upper half a distance of 5 millimeters. Pressure is removed and the position then taken by the pointer is regarded as zero; the pointer is now depressed 10 mm more; any rebound is taken as a measure of gel formation.

Experience shows that a good grease will not form a gel and hence the pointer does not rise.

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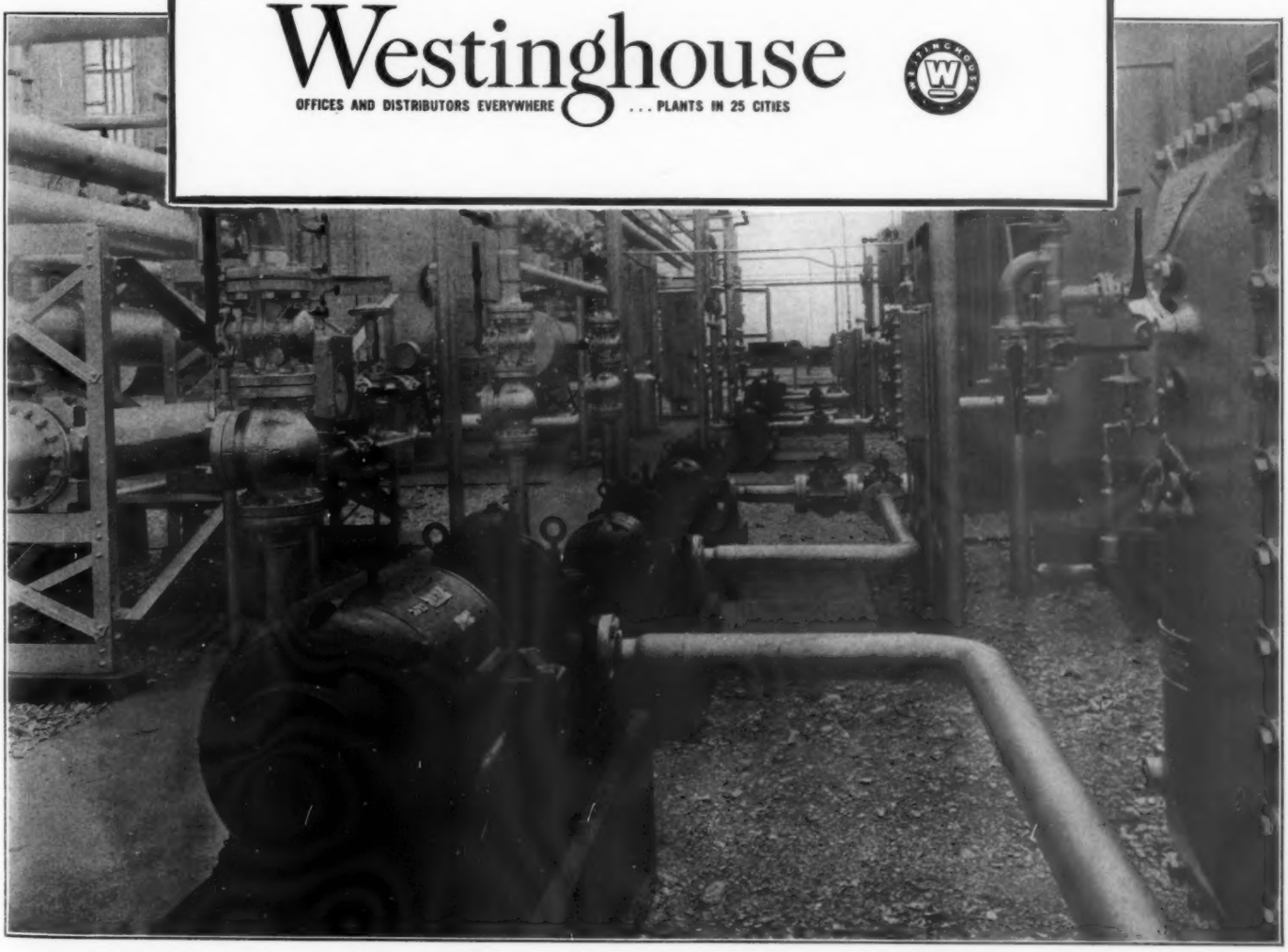
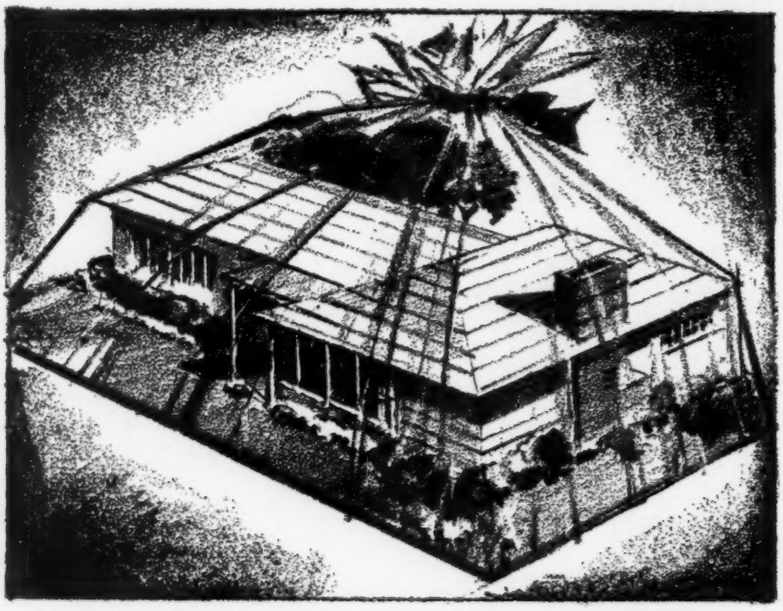


GENERAL

Comparison of Laboratory Diesel Engine Tests With Service Performance—R. S. Wetmiller and Bruce Hegeman, before Diesel Engine and Fuels and Lubricants Meeting, SOCIETY OF AUTOMOTIVE ENGINEERS, Cleveland, June, 1943.

General Motors 2-Cycle Diesel Engines have been used for the past several years to evaluate the performance of lubricating oils by the 500-hour laboratory test procedure. In this paper the authors describe a field test of approximately 580,000 engine miles carried out on G. M. Diesel powered buses through the cooperation of the Greyhound Corporation. The behavior of the oils used in these bus tests was compared with their behavior as previously determined in 500-hour laboratory tests. This comparison showed that the tests under the G. M. 500-hour procedure are, in general, more severe than in the field tests conducted by the authors. Although the laboratory tests were of only half the duration of the field tests they showed generally heavier deposits, particularly on the piston and in the air ports. This is probably associated with the higher temperatures occasioned by the sustained fuel load operating conditions employed. Hence the G. M. Model 71 Diesel 500-hour laboratory test depreciates the performance of the oils somewhat beyond what would be expected of them under reasonably heavy duty operations.



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